



FE Series

FE series four-point battery forklift

FE15/18/20/25/30/35RY FE20XRY

FE15/18/20/25/30/35RJ FE20XRJ

FE15/18/20/25/30/35RYL FE20XRYL

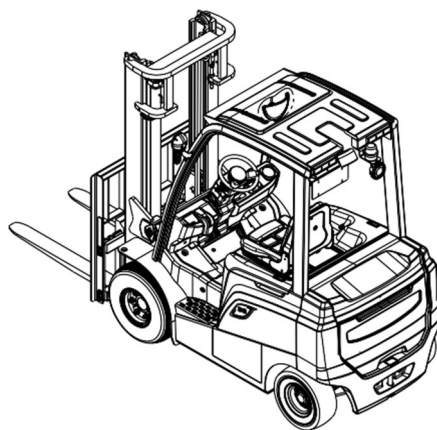
FE15/18/20/25/30/35RH FE20XRH

FE15/18/20/25/30/35R FE20XR

FE15/18/20/25/30/35RHL FE20XRHL

FE15/18/20/25/30/35RL FE20XRL

SERVICE MANUAL



Original Instruction

REDDOT EQUIPMENT LIMITED

09 / 2020

FOREWORD

Thank you very much for purchasing FE series four-wheel electric forklift truck of REDDOT. FE series four-wheel electric forklift truck is a newly developed product of our company, it owns characteristics as beautiful shape, good stability and superior performance,

This manual is brief introductions and correct operation of 1.5t~3.5t FE series four-wheel electric forklift truck, which will tell you how to operate safely and maintain preventively; relative persons must read and understand the manual before using the truck.

Due to the continuous updating and improvement of our products, there may be minor discrepancies between your forklift truck and this manual.

For any questions, please contact REDDOT or your nearest dealer.

Model	Traction control	Pump control	Rated capacity(t) / Load center (mm)
FE15/18RY/FE15/18RLY FE20XRY/XRYL	MC3336-A850	MC3336-A850	1.5/500,1.8 / 500 2.0/500,2.0/500
FE20/25RY/RYL	MC3336-A850	MC3336-A850	2.0/500,2.5 / 500
FE30/35RY/RYL	MC3336-A850	MC3336-A850	3.0/500,3.5 / 500
FE15/18RJ FE20XRJ	RD-B1	RD-B1	1.5/500,1.8 / 500 2.0/500
FE20/25RJ	RD-B2	RD-B1	2.0/500,2.5 / 500
FE30/35RJ	RD-B3	RD-C2	3.0/500,3.5 / 500
FE15/18RH FE20XRH	ACS48S-350C -35P	HP48/350	1.5/500,1.8 / 500 2.0/500
FE20/25RH	ACS48S+-450 C-35P	HP48/500	2.0/500,2.5 / 500
FE30/35RH	ACS48L-440C- 35P	HP80/500	3.0/500,3.5 / 500
FE15/18R FE20XR	ACS48S-350C -35P	ACS48S-350C -23P	1.5/500,1.8 / 500 2.0/500
FE20/25R	ACS48S+-450 C-35P	ACS48S-350C -23P	2.0/500,2.5 / 500
FE30/35R	ACS80M-440C C-35P	ACS80M-330 CC-23P	3.0/500,3.5 / 500
FE15/18RHL FE20XRHL	ACS80S-220C -35P	HP80/500	1.5/500,1.8 / 500 2.0/500
FE20/25RHL	ACS80M-330C -35P	HP80/500	2.0/500,2.5 / 500
FE30/35RHL	ACS80L-440C -35P	HP80/500	3.0/500,3.5 / 500
FE15/18RL FE20XRL	ACS80S-220C -35P	ACS80S-220C -23P	1.5/500,1.8 / 500 2.0/500
FE20/25RL	ACS80S-330C -35P	ACS80S-220C -23P	2.0/500,2.5 / 500
FE30/35RL	ACS80M-440C -35P	ACS80S-330C -23P	3.0/500,3.5 / 500

Model	Traction control	Pump control	Rated capacity(t) / Load center (mm)
FE20XRYLD	MC3336-A850	MC3336-A850	2.0/500

CONTENT

FOREWORD

1. Drive system.....	2
Permanent magnet motor.....	2
JS24Y Reduction gearbox.....	10
1.0t~1.5t DCS15H5 forklift gearbox	12
2.0t~3.5t forklift DCS25H/DCS30 gearbox.....	15
Driving axle	19
2. Steering system	24
Structure of Steering System	24
Structure of Steering Device	25
Troubleshooting and corrections on the steering system	28
3. Brake system.....	31
Foot brake piping system and brake master cylinder	31
Hand brake device	33
Foot brake	34
4. Hydraulic system	36
Main pump	37
Control valve	38
5. Lifting system	40
Data.....	40
Fault	41
Mast	42
Lifting cylinder	44
Tilting cylinder	44
6. Electrical system.....	45
Controller.....	45
Electrical system principle diagram	65

1. Drive system

The drive system is composed of components such as motor, reduction gear box, drive axle, brake, tire and rims etc.

The gearbox adopts a three-stage parallel shaft and differential structure, which is small and compact.

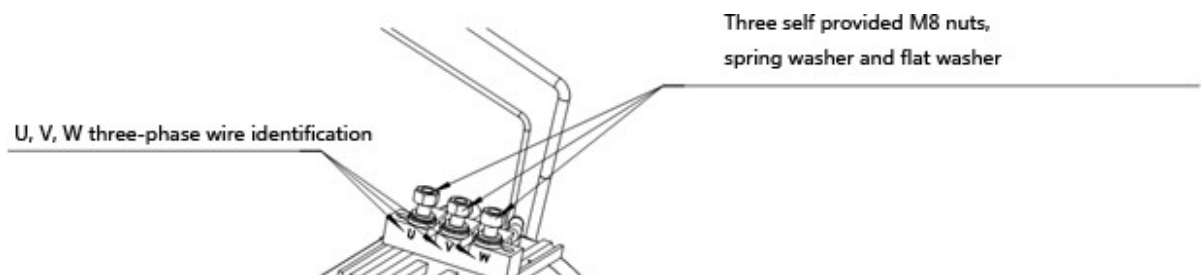
The brake is a wet brake, refer to the relevant part of the brake system for details

Permanent magnet motor

Model	Rated power kW	Rated voltage V	Rated current A	Rated speed r/min	Max. speed r/min	Insulation grade	Cooling method	Protection level	Quota min	Weight kg
TZ210BX-6Kw80V	6.0	80	80	3200	4600	H	Natural cooling	IP54	S2-60	26
TZ210BX-9Kw80V	9.0	80	115	3200	4800	H	Natural cooling	IP54	S2-60	31
TZ210BX-5Kw80V	5.0	80	75	1600	2600	H	Natural cooling	IP54	S3-15%	34
TZ210BX-7Kw80V	7.0	80	100	1800	2600	H	Natural cooling	IP54	S3-15%	36.6

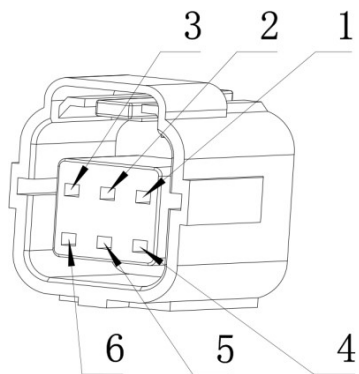
Electrical connection:

Connect the U, V, and W three-phase power wiring harness to the three bolts of the wiring post, and fix them with nuts.

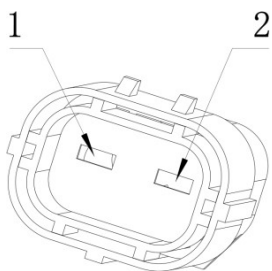


Connect the controller resolver signal harness to the motor resolver signal outlet.

Signal lead interface definition



Pin No.	Color	Definition	Remark
1	White	SN+	Resolve 52UX7103A
2	Blue	SN-	
3	Yellow	COS+	
4	Green	COS-	
5	Red	OE1	
6	Black	OE2	



Pin No.	Color	Definition	Remark
1	Red	Temp+	Thermistor KTY84-130
2	Black	Temp-	

Commissioning and operation

Before the motor is energized, please check whether the mechanical connection and electrical connection are safe and reliable. If abnormal sound or vibration of the motor is found during operation, please stop the motor immediately, cut off the power supply, check the motor and load equipment, and put it into operation again after troubleshooting.

Daily check

1. Whether the wiring part is loose or not, if it is loose, tighten it again.
2. Whether the wire insulation layer is damaged, if it is damaged, it must be wrapped with insulating materials such as insulating tape.
3. Whether the mounting bolts are loose, if they are loose, they must be tightened again.
4. If the motor needs to be disassembled for internal maintenance and repair, it must be carried out by a professional manufacturer. When the motor is reassembled, all fasteners shall be coated with thread fastening glue.

DC motor

Model	Rated power kW	Rated voltage V	Rated current A	Rated speed r/min	Max. speed r/min	Excitation way	Insulation class	Cooling method	Protection level	Quota min	Weight kg
XQD-8.2-3D-1	8.2	45	240	1600		In series	F	IC01	IP20	60	47
XQD-8.6-3D/80	8.6	75	142	1600		In series	F	IC01	IP20	5	47
XQD-8.6-3D-1	8.6	45	248	1600		In series	F	IC01	IP20	5	47
XQD-10-3D-2H	10.0	75	160	2000		In series	F	IC01	IP20	15	90

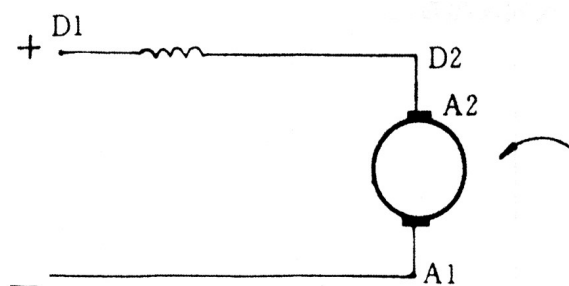
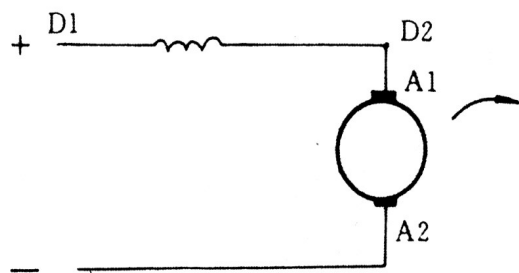
Motor outlet cable or pile head label, mode of connection

Series excited motor	A1	Armature winding head
	A2	Armature winding end
	D1	Series winding head
	D2	Series winding end
Separately excited motor	A1	Armature winding head
	A2	Armature winding end
	F1	Separately excited winding head
	F2	Separately excited winding end

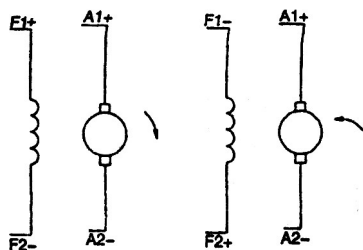
Mode of connection :

Series excited motor

Commutator rotation direction



Separately excited motor



Motor applied range	Altitude	Not higher than 1200m
	Ambient temperature Highest/lowest	40℃/-25℃
	Relative humidity	Until 100% condensation is formed on the surface of the motor
	Cooling air	No explosive gas
Max. motor working current	Traction motor	Three times of rated current, allowable time is one minute
	Lifting, steering motor	1.8 times of rated current, allowable time is one minute
Allowable temperature of rolling bearing(temperature not surpass +40℃)		95℃
Cooling insulation resistance(measure with 250V Megohmmeter when near working temperature)		<45V, 0.5MΩ; 45V~110V, 1MΩ
Distance between brush box and commutator surface		2mm~4mm
Brush		Metal graphite brush trade mark J201 picture no. 5CZ, 578

DC motor fault diagnosis

Fault	Probable cause
All copper sheet blacken	· Pressure of the brush is not right
Commutator segments blacken in group according to certain sequence	· Short circuit of commutator segments
	· Short circuit of armature coils
	· The welding of commutator segments and armature coils is not good or short circuit.
Commutator segments blacken, but without sequence	· Center line shift of the commutator
	· Rough, un-round of the commutator surface
Wear, color change and fracture of brush	· Motor vibrate
	· Gap between brush and brush box is too large
	· The distance between brush box and commutator working surface is too long
	· The mica between commutator segments extrudes.
	· Brush material is not good.
	· Trade mark of brush is not right
Large spark	· Overloaded of motor
	· Commutator is not clear
	· Commutator is not smooth or round
	· Mica plate or part commutator segment extrude
	· Brush does not grind well
	· Brush pressure is not large enough
	· Incorrect brush trade mark
	· Brush locked in the brush box
	· Brush carrier loosen or vibrate
	· Incorrect pole polarity and sequence
Brush and brush wire overheat	· Large brush spark
	· Electrical brush and flexible conductor have bad contact
	· Small flexible conductor area
Noise in the brush	· Uneven commutator surface

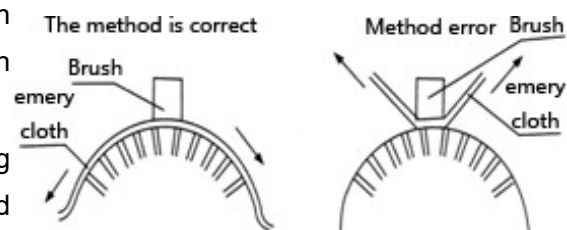
DC motor use and maintenance

Commutator end has four inspection windows for observing and maintaining commutator and changing brush. There is four uniformly distributed poles in motor seat, pole coil is rolled with F grade copper wire and immerse F grade insulating varnish, stator parts and brush neutral position has adjusted at test station, so users should not dismantle and adjust at will.

- Check if motor rotates flexibly or abrades.
- Check if motor outlet(or terminal) connection is correct or reliable.
- Brush should slide easily in the brush box.
- Check if commutator segments are clean, if necessary, clean the minor groove of commutator segments and carbon powder on the commutator surface with soft clean white cloth, when there is grease on the surface, immerse the cloth in alcohol to wipe(park).
- Check if all fasteners are tight.
- Brush carrier should be tight and no loose. If it needs to turn or remove the brush carrier, only mark can loosen the end cap bolt.
- Aim at marker line to tighten screw when brush carrier reset to keep the brush in neutral position.
- Check the coil insulation resistance regularly, when close to working temperature, it should not be lower than defined data, otherwise dry.
- Open the shutter regularly and check if the inner parts deformation or reversing part is normal.
- Often clean sand and other adhesion on the motor in order not to affect its heatdissipation.
- Check the motor at least once half year according to the following way:
 - Check the outer part and clean dust on the motor;
 - Clean and replace bearing, listen if there is abnormal noise during running;
 - Check brush abrasion and replace if necessary.

Brush abrasion:

- When replace brush, use 00 type abrasive cloth to polish, pull abrasive cloth to left or right when polishing.
- After polishing abrasive cloth and cleaning commutator, motor should work under limited speed to ensure safety until the brush working surface polishes.



AC motor

Model	Rated power kW	Rated voltage V	Rated current A	Rated speed r/min	Max. speed r/min	Insulation grade	Cooling method	Protection grade	Duty	Weight kg
HPB8.6-4	8.6	31	248	1600	3200	F	IC00	IP44	S3-15%	65
HPB10-4HC	10	51	161.6	2000	/	F	IC01	IP44	S3-15%	80
HPQ8-4HC-B	8	33	182	3158	4500		IC411	IP20		82.5
HPQ11-4HC-B	11	33	241	2783	4500		IC411	IP20		94
HPQ15-4HC-B	15	55	198	2731	4500		IC411	IP20		102
XYQ-15-B	15	51	260	1200		H		IP54	S2 60min	140
XYQ-11-B	11	31	245	1400		H		IP54	S2 60min	110
XYQ-8A-B	8	31	170	1400		H		IP54	S2 60min	110

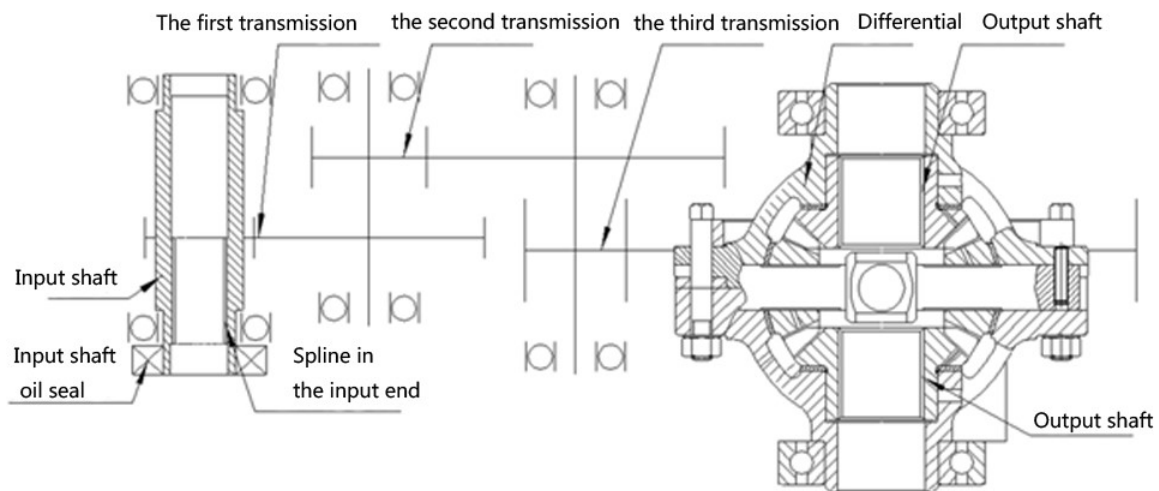


Caution

- AC motor does not have commutator and brush. No maintenance. But it needs regular inspection and dusty clearing.

JS24Y Reduction gearbox

The reduction gearbox is a three-stage reduction, and the input shaft is connected with an internal spline shaft and an external spline shaft of the motor. The large gear at the output end is finally driven by the first transmission, the second transmission, and the third transmission. The output end gear wheel and the differential housing are fixed that drives the differential to rotate to realize the deceleration function.



The symmetrical bevel gear differential used in this reduction gearbox is a planetary gear mechanism. The differential case is connected with the planetary gear shaft to form a planetary carrier. And it is fixedly connected with the gear wheel, so it is the driving part. The planetary gear meshes with the two side gears. When the planetary gear revolves around the axis of the differential with the planet carrier (that is, the planetary gear and the side gears are relatively stationary), the differential does not function as a differential. When the forces on the left and right side gears are different, the side gears with large forces will drive the planetary gears to rotate on its own axis in addition to revolution (that is, the relative motion of planetary gear and side gears). The gear produces a speed difference, that is, it has a differential speed.

Installation

1) Reducer and axle installation

The axle mounting surface is upward, and the reducer is vertically downward by hoisting the 26 frame fixing hole, and the sealant is evenly applied to the output stop and the output end surface (Silicon 586 silicone gasket-free sealant is recommended), and put the output end of the reducer into the axle tooth package, install the positioning pins in the positioning pin hole 1 and hole 2 of the reducer. Install and tighten 10×M12 screws after applying thread fastening glue (Loctite 243 glue anaerobic thread fastening glue is recommended), and the recommended torque value is 110~130NM.



Warning

- When installing the reducer, please use mechanical devices to assist in transportation, do not carry it manually.
- Auxiliary hoisting hole 9 can be used for auxiliary hoisting during installation or for subsequent maintenance of hoisting holes.
- During transportation or installation, be careful not to bump the gear of the reducer to avoid abnormal noise.

2) Installation of axle shaft at both ends of axle

Just install it in accordance with the axle installation method, ensuring that the axle shaft outer spline is inserted into the inner spline of the output end of the reducer.

3) Reducer and motor installation

Install the motor into the reducer, first install the outer spline shaft of the motor into the inner spline of the reducer input end, after moving, position the motor and the input end of the reducer, then install 4×M10 bolts and tighten them diagonally, the recommended tightening torque is 55~70N.M.



Caution

- Before installation, check whether high temperature grease is applied to the spline of the input shaft of the reducer. If it is not applied, apply high temperature grease to fill the spline groove.
- During the entire installation process, make sure that there are no foreign objects in key locations such as the installation surface and the stop.

1.0t ~ 1.5t DCS15H5 forklift gearbox

Parameter

Rated input power (kW)		5
Rated input speed		1480 r/min
Reducer	Reduction gear	Reducer
	Reduction ratio	
Differential	Reduction gear	Differential
	Reduction ratio	
	Differential gear	
Direction of rotation		From the input end of the gearbox, the input is clockwise and the output is reverse rotation; When the input is counterclockwise, the output is forward rotation.
Lubricating oil	Model, brand	Lubricating oil
	Oil capacity	

Fault diagnosis and corrections

Fault	Probable reason	Corrections
Low transmission efficiency and high oil temperature	· Insufficient oil level and poor lubrication · Unqualified oil quality · Wear and damage of gear or bearing	Ensure the oil level within the specified oil level range Replace with new oil Replace the gear or bearing
Rotation impact caused by unstable operation	· Gear or bearing damage	Replace the gear or bearing
Oil leakage	· Aging or damage of O-ring or cup · Parts cracked or damaged	Replace O-ring or cup Replace parts

Summarization

The gearbox used by 1.0t~1.5t FE series battery forklift is unique. It consists of only a pair of straight gears. The gear wheel is directly mounted on the driving gear of the final drive, and the pinion is mounted on the motor output shaft. The gearbox case does not support any shafts or gears. See Figure 2-2.

The main reducer is modified from the single-stage spiral bevel gear used in BJ130 cars, and the differential uses BJ130 auto parts. Its unique feature is that the transmission case and the main reducer assembly are separable. Therefore, full attention should be paid to its uniqueness during maintenance.

The gearbox does not need to change gears, but directly relies on the forward and reverse rotation of the motor to achieve forward or reverse operation, with good reliability and easy maintenance.

Transmission principle

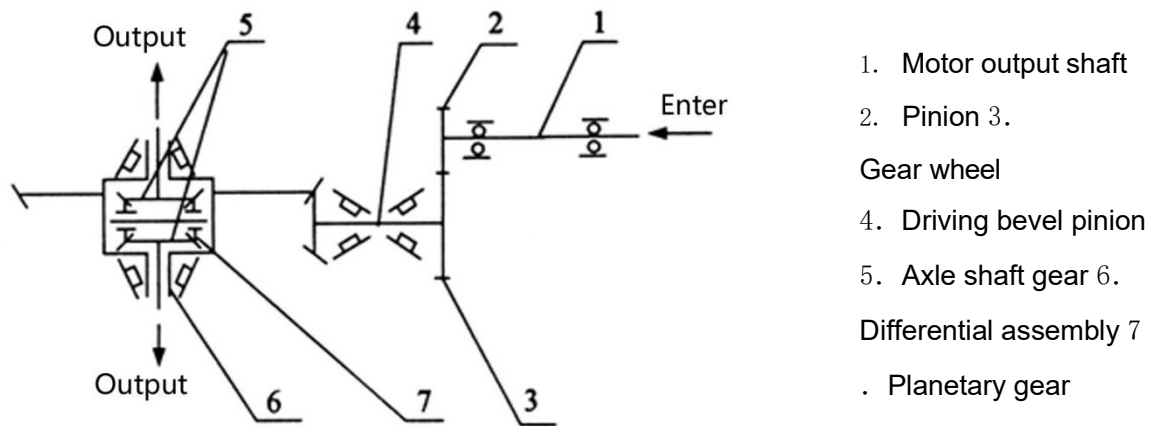


Fig. 2-1 Transmission diagram of 1t~1.5 t battery forklift gearbox

The transmission diagram of the 1t-1.5t battery forklift gearbox is shown in Figure 2-1. The pinion shaft is driven by the motor output shaft. The power transmission sequence: 2→3→4→differential assembly 6→5.

Final drive

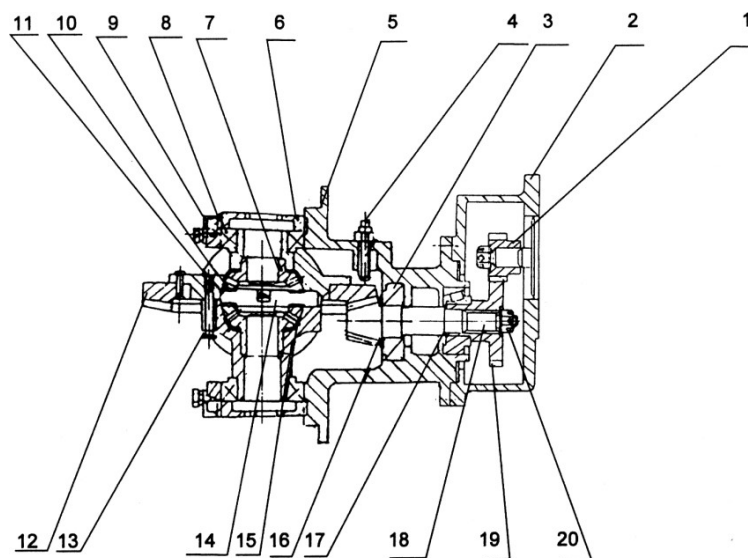


Fig. 2-2 Reducer, differential

1. Pinion	2. Box	3. Bearing	4. Thrust bol
5. Final drive housing	6. Adjusting nut	7. Axle shaft gear	8. Bearing
9. Locking plate	10. Planetary gear	11. Thrust washer	12. Driven arc bevel gear
13. Bolt	14. Universal joint pin	15. Shim	16. Adjusting shim
17. Adjusting shim	18. Driving arc bevel gear	19. Gear wheel	20. Nut

In fact, the final drive assembly is independent, and it is installed in the drive axle package. It reduces the speed from the gear wheel 19 and increases the torque, and then transmits this torque to the differential; the reducer is mainly composed of a driving arc bevel gear and a driven arc bevel gear.

Differential

Compared with the 2t~3t FE series battery forklift differential, the structure is similar. The difference is only in the driven bevel gear, which is riveted with the differential housing. For the rest, refer to the 2t~3t FE series battery forklift, that is 2.2.6 differential.

Overall disassembly and assembly

① Remove the connecting bolts between the box body 2 and the traveling motor, and remove the two nuts that fix the motor to the frame first.

② Remove the final drive from the drive axle, and pull out the axle shaft first.

③ Remove the differential.

④ Remove the gearwheel 19.

⑤ Remove the driving arc bevel gear assembly.

Note: If only the pinion and the gear wheel are inspected, only perform step ①.

Assembly is in reverse order to disassembly.

Adjustment

- ① The tooth side clearance and meshing situation of the driving and driven arc gears, the tooth side clearance is 0.2mm~0.26mm, which can be carried out by increasing or decreasing the adjustment shim 16. It can be easily rotated by hand without jamming. The meshing area along the tooth length and tooth height direction is not less than 60%, which can be checked by coloring method. This is achieved by increasing or decreasing the adjustment shim 16 to move the driving arc bevel gear, and at the same time adjust nut 6 to move the driven arc bevel gear.
- ② Preload of driving arc bevel gear bearing, The axial clearance of the driving arc bevel gear shall not exceed 0.05mm, and the bearing preload can be measured with a spring balance to measure the rotational torque, and its value is 0.59 Nm~137Nm. This can be achieved by increasing or decreasing adjustment shims 17.
- ③ Differential housing bearing preload, This preload is obtained by adjusting the adjusting nut 6.
- ④ Clearance between thrust bolt and driven arc bevel gear, After the thrust bolt is screwed in, it come contacts with the driven arc bevel gear, and then withdraws 1/3-1/4 turn, and lock it to ensure that the clearance is between 0.3mm and 0.6mm.

2.0t ~ 3.5t forklift DCS25H/DCS30 gearbox

Parameter

Model		DCS25H (2~2.5) t	DCS30H (3.0~3.5) t
Rated input power (KW)		6.3	10
Rated input speed		1200r/min	
Reducer	Spiral bevel gear	Spiral bevel gear	
	2.273	2.273	
Differential	Straight gear	Straight gear	
	6.182	6.182	
	Straight bevel gear	Straight bevel gear	
Direction of rotation		From the input end of the gearbox, the input is clockwise and the output is reverse rotation; when the input is counterclockwise, the output is forward rotation.	
Lubricating oil	Model, brand	GL-5 85W/90 gear oil	
	Oil capacity	4.4 liters	

Fault diagnosis and corrections

Fault	Probable reason	Corrections
Low transmission efficiency and high oil temperature	· Insufficient oil level and poor lubrication	Ensure the oil level within the specified oil level range
	· Unqualified oil · Wear and damage of gear or bearing	Replace with new oil Replace the gear or bearing
Rotation impact caused by unstable operation	· Gear or bearing damage	Replace the gear or bearing
Oil leakage	· Aging or damage of O-ring or cup	Replace O-ring or cup
	· Parts cracked or damaged	Replace parts

2.0t~ 2.5t FE series battery forklifts adopt DCS25H gearbox, 3.0t ~ 3.5t adopt DCS30H gearbox. The two gearboxes have similar structure and same principle. They are a mechanical gearbox composed of a pair of bevel gears and a pair of cylindrical gears with two-stage reduction transmission and a differential device. It has the characteristics of high efficiency, large transmission ratio and simple structure. The gearbox does not need to change gears, but directly relies on the forward and reverse rotation of the motor to achieve forward or reverse operation, with easy maintenance.

Transmission principle

The transmission diagram of the battery forklift gearbox is shown in Figure 2-1. The bevel gear shaft 1 is driven by the motor to drive the gearbox to run through the spline sleeve. The power transmission sequence: 1→2→3→4→differential assembly 6→5.

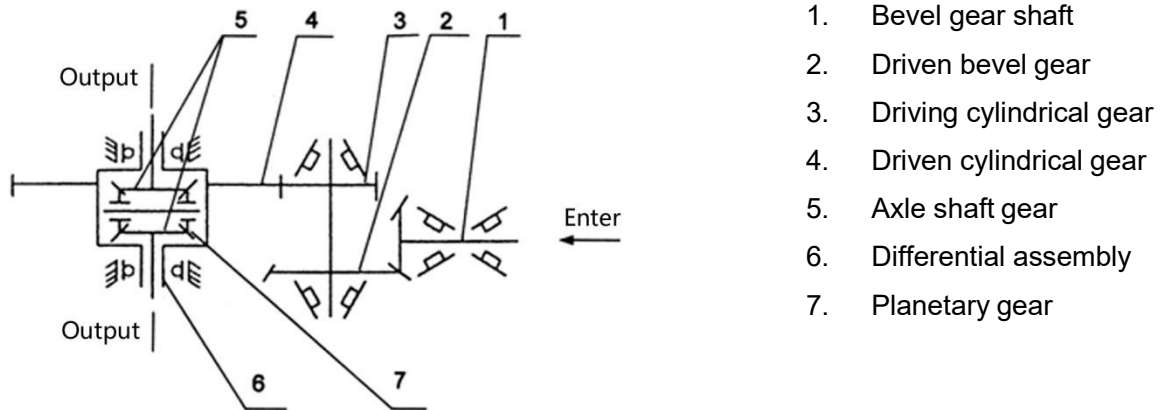


Fig. 2-1 Transmission diagram of DCS25H/DCS30H battery forklift gearbox

Reducer (see picture 2-2)

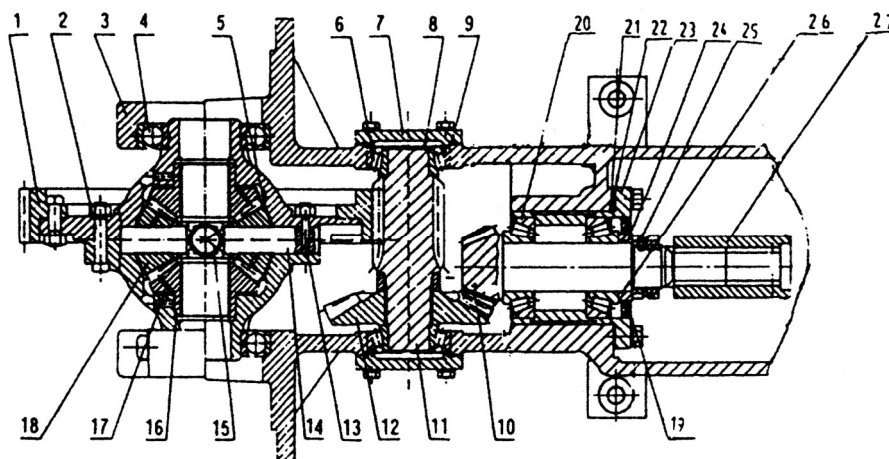


Fig. 2-2 Reducer, differential

1. Gear ring	2. Bolt	3. Bearing seat	4. Ball bearing	5. Thrust washer
6. Tapered roller bearing	7. Bearing cap	8. Shim	9. "O" ring	10. Bevel gear shaft
11. Pinion	12. Spiral bevel gear	13. Round pin	14. Gear shaft I	15. Gear shaft II
16. Axle shaft gear	17. Shim	18. Planetary gear	19. Seal ring	20. Tapered roller bearing
21. "O" ring	22. Adjusting pad	23. Bearing seat	24. Bush	25. Round nut
26. "O" ring	27. Spline housing			

Reducer is in the front of transmission, which reduces the speed of output shaft of

transmission and increase the torque from output shaft to differential; reducer is mainly composed by a small helical bevel gear on the output shaft, a big helical bevel gear and a small gear shaft, the big helical bevel gear is fixed in a small gear shaft through spline, two ends of small gear shaft are all held by taper roller bearing and adjusted gap by shim.

Differential (see Fig. 2-2)

Differential is installed on front half shell by bearing holder through ball bearing on both ends, and the front end is connected with the axle housing. Differential carriage is divided into left and right half, which is composed of two axle shaft gears and four planetary gears. Thrust ring is put between differential carriage and gears in order to have a clearance between pairs of gears. Planetary gear is held by gear shaft I,II. Gear shaft I is secured to differential carriage by columnar pin, and gear loop 1 is secured to differential carriage by ream bolt.

The power from transmission transmits to wheel through axle shaft gear and axle shaft when it is reduced to come into differential driving by differential.

Bevel gear shaft (see Fig. 2-2)

Both ends of the bevel gear shaft 10 are supported on the box body by tapered roller bearings through the bearing seat 23. An adjustment pad is installed between the bearing seat and the box body to adjust the bevel gear shaft in the correct installation position. The lock nut is used to pre-tighten the tapered roller bearing 20. A locking nut installed at the tail end of the bevel gear shaft is used to pre tighten the tapered roller bearing 20.

Overall disassembly of the differential

Removal of transmission is according to following procedures

Remove differential (see Fig. 2-2)

- ① Take down bolts securing bearing seat of differential.
- ② Take down the section of differential from transmission.
- ③ Loose and take down bolt 2 and column 13, detach differential left hull from right case.
- ④ Take down thrust washer 5, gear 14, planetary gear 18, semi-axle gear 16, washer 17, gear shaft 15 etc. respectively.



Caution

Be sure to lay adjust shim respectively and not to be mixed up.

Remove reduction gear (see fig 2-2)

- ① Loose and take down the fixing bolts of two ends of bearing cover 7.
- ② Gently tap the front of pinion 11 near helical bevel gear.
- ③ Take down bearing 6, pinion 11 and helical bevel gear 12.



Caution

Remember the location of adjust shim 8, the adjustment pads at both ends should be placed separately and not be mixed up

Assembly

Assembly is in reverse order to disassembly. But it should be noted the following:

- ① Prevent each fixing connecting face and gear tooth surface from knocking to be damaged.
- ② Apply working faces of parts such as bearing, gear, seal ring and relatively movement parts with a little gear oil to prevent them from coming into being instant dry friction while early running.
- ③ Each part should be assembled correctly.
- ④ Each part should be running smoothly to prevent it from getting stuck.
- ⑤ Be sure to tighten each joint bolt firmly.

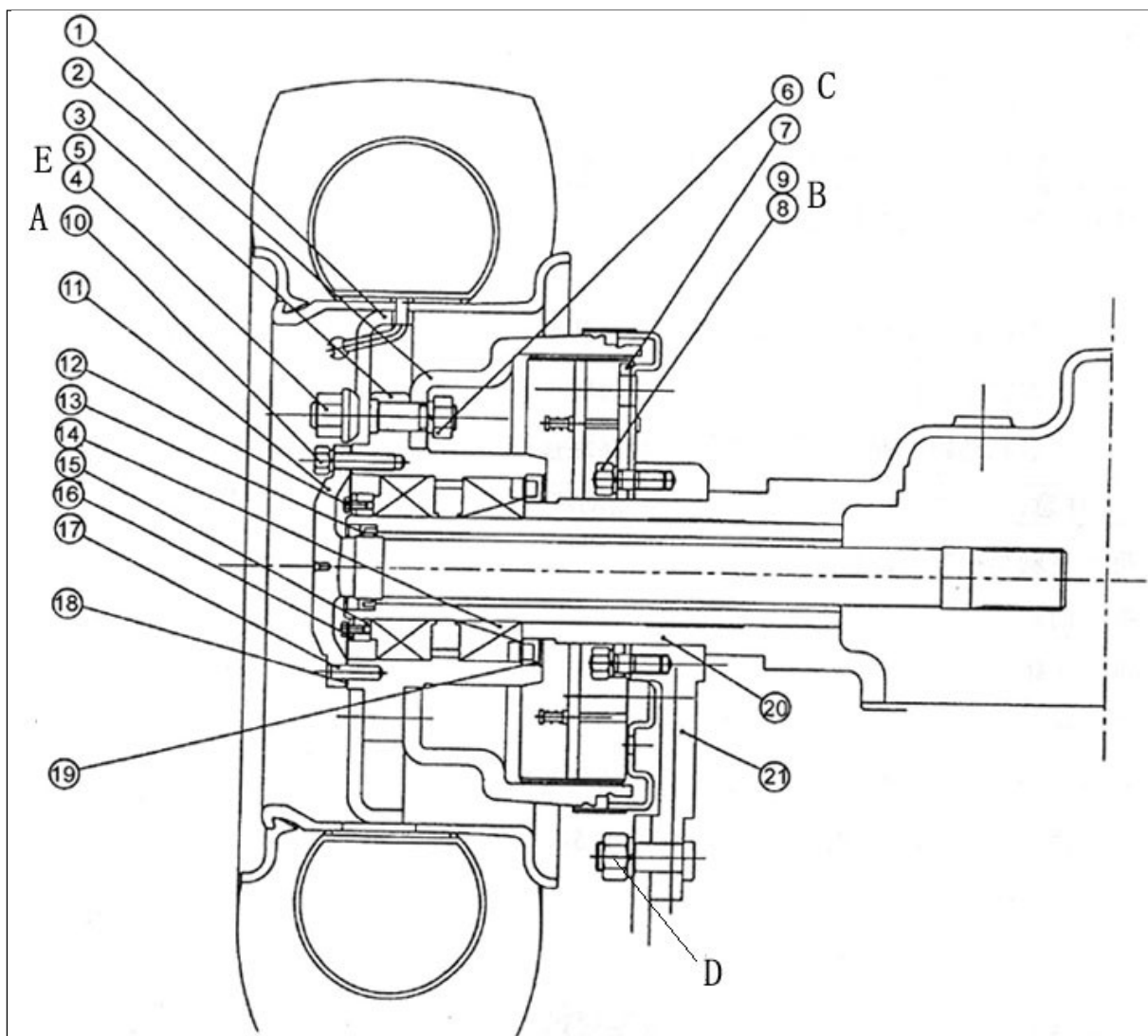
Driving axle

Data

Model		1.0t~1.8t	2.0t~2.5t	3.0t~3.5t
Driving axle type		Full floating, axle and truck body direct install, front wheel driving		
Tire pressure	MPa	0.79	0.9	
Wheel hub rotation starting torque at hub blot	N	10~29		
Axial play of wheel bearing	mm	less than 0.08		
Weight	kg	125~130	195~198	202~208

Trouble diagnoses and corrections

Condition	Probable cause	Corrective action
Abnormal noises	Loose driving axle and body connecting blots.	Tighten
	Loose wheel nut	Tighten
	Worn or damaged wheel hub bearing.	Replace
	Wheel hub bearing not properly adjusted.	Adjust
	Worn axle shaft spliner.	Replace
	Insufficient lubrication	Lubricate
Unstable driving	Loose wheel nut.	Tighten
	Deformed wheel.	Replace
	Worn or damaged wheel hub bearing.	Replace
	Loose driving axle and body connecting blots.	Tighten
	Wheel hub bearing not properly adjusted.	Adjust
	Improper tire pressure.	Adjust
Oil leakage	Worn or damaged axle shaft oil seal.	Replace
	Final drive improperly installed.	Replace gasket
	Loose drain plug.	Tighten.



1. Rim	2. Brake drum	3. wheel hub	4. Wheel nut	5. Wheel hub bolt
6. Bolt	7. Brake assy	8. Wash	9. Bolt	10. Half-axle nut
11. Half axle	12. Bolt	13. Oil seal	14. Taper roller bearing	15. Adjusting nut
16. Lock nut	17. Pin	18. Paper shim	19. Oil seal	20. Axle case
21. Supporter				

Driving axle

Tighten torque: N.m

	1.5t~1.8t	2.0t~3.5t
Axle shaft bolt (A)	44N·m~58N·m	73.5 N·m~88.3 N·m
Trig soleplate bolt (B)	76 N·m ~107 N·m	118 N·m~147 N·m
nut connecting brake drum and hub (C)	160 N·m ~190 N·m	324 N·m~373 N·m
Bolt and nut connecting support plate and truck body (D)	260 N·m ~347 N·m	
Tyre nut (E)	157 N·m ~176 N·m	441 N·m~588 N·m

Driving axle assemble removal and installation



WARNING

- Be careful when removal and installation driving axle as it is heavy.

- (1) Raise front end of forklift truck and support frame with wooden blocks.
- (2) Remove mast assemblies.
- (3) Slightly raise axle with a hoist and place wooden blocks under differential gear carrier and transmission case.
- (4) After placing a pan under axle case, loose oil plug, drain oil from axle case.
- (5) Disconnect brake nuts from left and right cylinders.(see fig.1-1) .



CAUTION

- Plug brake tube openings to prevent oil from flowing out.

- (6) Disconnect brake cable at hand brake lever.
- (7) Remove front wheels.
- (8) Remove axle shaft.
- (9) Support driving axle with wire ropes and lifting device.
- (10) Remove bolts securing axle mounting bracket to frame. (see fig.1-2) .
- (11) Remove nuts securing axle case to differential gear carrier. (see fig.1-3) .
- (12) Remove driving axle assemble.

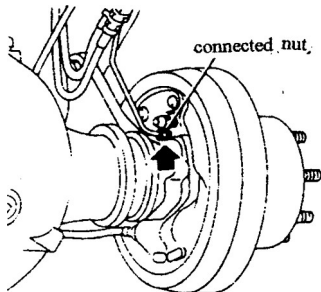


Fig.1-1

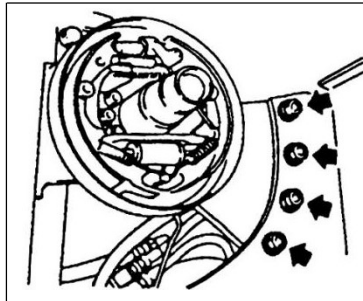


Fig.1-2

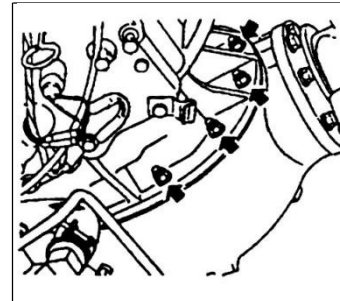


Fig.1-3

- (13) Remove the lock nut (use the special tool F-type wrench) and the lock piece.
- (14) Remove brake drum, remove wheel hub.
- (15) Remove axle mounting bracket and brake component from axle tube.
- (16) Remove oil seal from axle tube.
- (17) To install driving axle assemble in the reverse order of removal. Observe the following:
 - ①When installing axle mounting bracket and brake component, apply a coat of calcium grease to axle tube.
 - ②Apply 1/3~2/3 of volume of calcium grease to wheel hub, then install them on axle tube.
 - ③Install oil seal with its part number facing to the inside of forklift truck.

④attach seal tape (PVC, white) to drain plug then installed after cleaned it.

⑤Replenish axle case with gear oil. Tighten vent plug after clearing.

Gear oil GL-5 85W/90 (Cold storage forklift selection: GL-5 80W/90)	1.0t~1.8t	4.5 L
	2.0t~3.5t	6.0 L



CAUTION

- Vent plug should clear instantly to prevent pressure inside of wheel hub from rising.

Axle shaft and wheel hub

Remove

- (1) Raise the front end of forklift truck and support frame with wooden blocks.
- (2) Remove front wheel and axle shaft.
- (3) Remove lock nuts, lock washers, snap ring, felt ring, adjusting nut. Use special tools.
- (4) Remove brake drum (refer to Fig.1-4);

If brake drum is difficult to remove:: a. Remove adjusting hole plug. Then with flat-blade screwdriver extend adjusting hole, turn adjusting ratchet wheel by 10 notches. To contract brake shoe lining(refer to Fig.1-5). b. evenly tapping on brake drum with brass bar or wooden mallet.

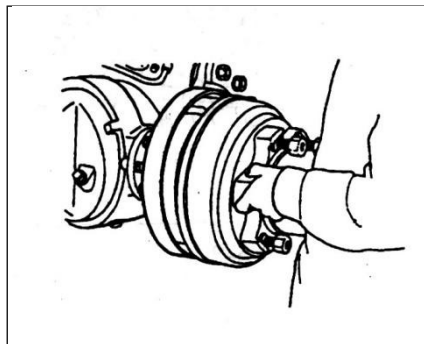


Fig.1-4

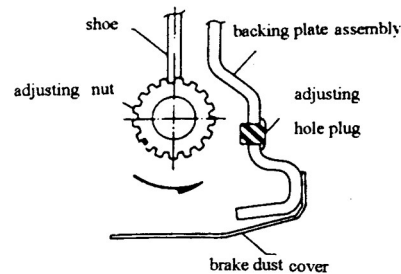


Fig.1-5

- (5) Remove wheel hub, be careful not to drop bearing inner race.
- (6) Remove oil seal and inner bearing as an assembly by evenly tapping on periphery of seal with a wooden mallet and brass bar.
- (7) Remove bearing outer race from wheel hub by evenly tapping on its periphery with a wooden mallet.



CAUTION

- Be careful not to damage oil seal and outer race.

Inspection

Stepped wear or cracks on axle shaft splines	Replace
Seized, scratched, noisy or rusted bearing or improper rotation of rollers	Replace
Cracked or damage wheel hub	Replace
Damaged oil seal felt ring.	Replace

Installation

Install reverse order of removal.

Bearing adjusting

- (1) Lubricate on taper roller bearing.
- (2) Tighten roller bearing lock nut in wheel hub until wheel hub can no longer be rotated with one hand.
- (3) From that position, turn back lock nut approx. 60° .
- (4) Turn back wheel hub two or three rotations so that bearing settles down.
- (5) Again tighten lock nut until it can no longer be rotated with one hand; then turn back approx. 60° .
- (6) Install snap ring and settles down felt ring, install lock washer so as to set its hole in the pin of snap ring. Screw lock nut.
- (7) Turn wheel hub back and forth two or three rotations to see if rotation starting torque is within specifications. Rotation starting force: $10 \sim 29\text{N}$ (refer to Fig.1-6) .
- (8) Measure axial play of wheel hub to see if it is within specification. Axial play is less than 0.08mm (refer to Fig.1-7) .

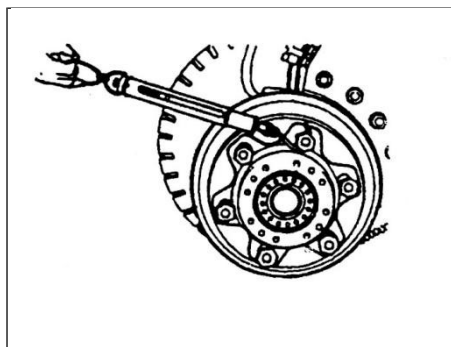


Fig.1-6

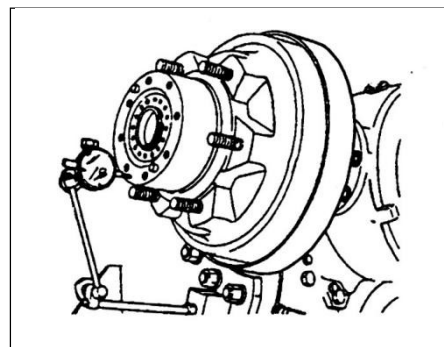


Fig.1-7

2. Steering system

Structure of Steering System

The steering system consists of steering device and steering axle assembly. See figure 2-1.

The steering device is composed of steering wheel assembly, steering tube device, locking handle and the hydraulic diverter. See figure 2-2. Both the steering column and steering wheel can be put forward and backward by an angle of 6° which can meet the requirements of different operators. When the truck is disconnected, turn the steering wheel by a force of 1kg and release. The steering wheel can return by an angle of 10° automatically.

The steering axle assembly is composed of the steering axle, steering knuckle, steering hub, steering wheels and steering cylinders. See figure 2-3.

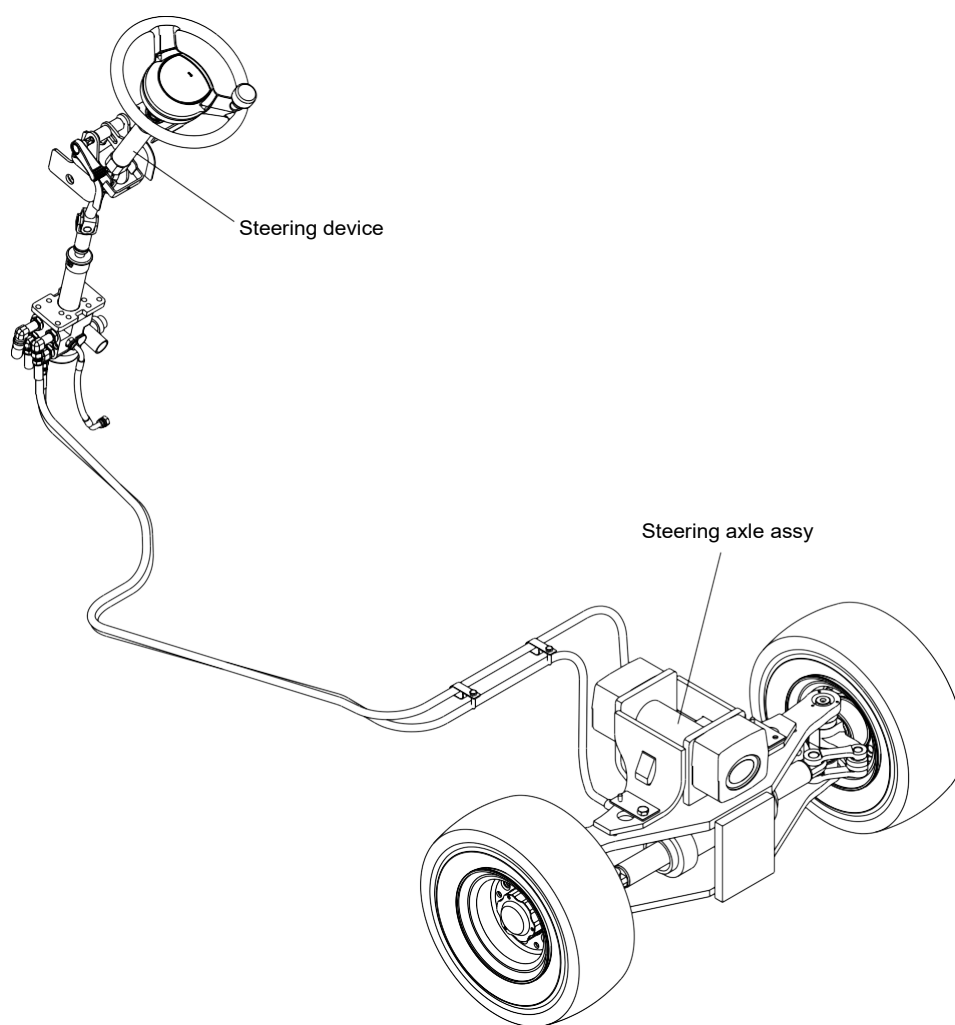


Figure 2-1 Steering System

Structure of Steering Device

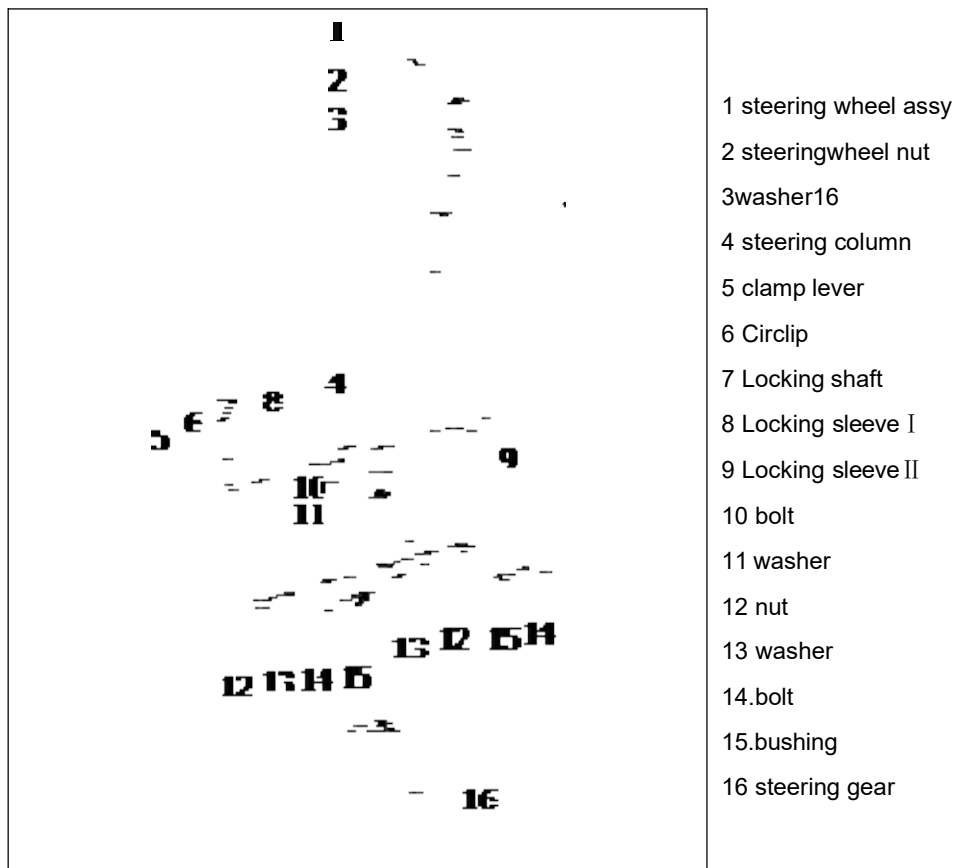


Figure 2-2 Structure of Steering Device

No.	Specification	Tightening torque	Note
2	M16×1.5	26.5 Nm~32.5Nm	Steering wheel nut
10	M10×20	15.7 Nm~21.6Nm	bolt
12	M12	58 Nm~78 Nm	nut

Steering Axle

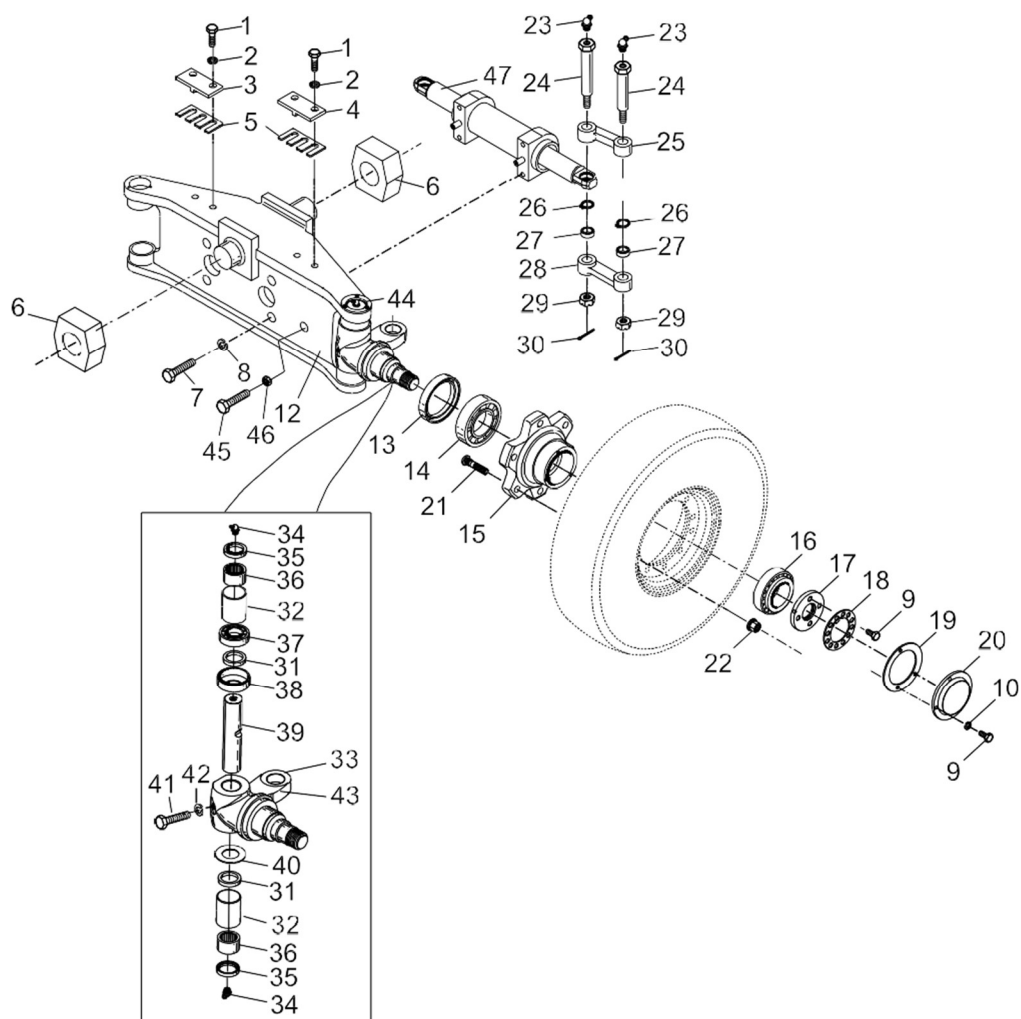


Figure 2-3 Steering Axle

1. bolt	2. washer	3.right stop plate	4.left stop plate	5.adjusting washer
6.master pin	7. right master pin	8. damper	9. screw	10.washer
11.cover plate	12.bolt	13.washer	14.steering axle	15.oil seal
16.bearing	17.fastening bolt	18.steering hub	19.bearing	20.lock nut
21.lock washer	22.sphere nut	23.paper pad	24.end cap	25.grease cup
26.pin roll	27.pin roll	28.snap ring	29.bearing	30.bottom connecting rod
31.upper connecting rod	32.snap ring	33.bearing	34.nut	35.pin
36.grease cup	37.oil seal	38.bearing	39.bearing	40.dustproof cover
41.master pin	42.fastening bolt	43.left knuckle	44.steel bushing I	45.steel bushing II
46.adjusting washer	47.cover	48.sensor	49.cover	50.cover
51.retainer plate	52.rigt knuckle	53. nut	54. bolt	55.steering cylinder

Key Data

Axle Type	Centre bearing, rotational		
Steering angle	Maximum steering angle of inside wheels	1.5t~1.8t	79.5°
		2.0t~3.5t	80°
	Maximum steering angle of outside wheels	1.5t~1.8t	56°
		2.0t~3.5t	55.7°
Longitudinal clearance mm	0~1		
Adjusting washers for longitudinal clearance	N163-220020-000 (δ =0.5mm、1.0mm、1.6mm)		

Kingpin

Axial clearance of kingpin	$\leq 0.20\text{mm}$
Adjusting washers for kingpin(46)	N163-220012-000 (δ =0.1mm、0.3mm、0.7mm) three kinds

Hub bearing

Pretightening force	Screw down the nut of knuckle till the hub cannot be removed with hand. Or stop when the torque of hub bolt reaches 10 to 29 Nr. Turn the nut slightly to 1/8 to 1/6 of one circle.
Axial clearance	No clearance in the axial direction

Tightening torque for key fasteners

Note: Tightening torque is measured on basis of the key fasteners are not lubricated. No grease on the bearing surface of bolts and nuts.

No.	Specification	Tightening torque	Note
1	M10×1.25×30	40.9 N·m~49 N·m	Bolt (figure 2-3)
9	M6×12	8.5 N·m~10.2 N·m	Bolt (figure 2-3)
12	M14×1.5×40	176 N·m~212 N·m	Stop bolt (figure 2-3)
22	M16×1.5	176 N·m~212 N·m	Sphere nut (figure 2-3)
42	M10×1.25	40.9 N·m~49 N·m	Fixing bolt (figure 2-3)

Troubleshooting and corrections on the steering system

Condition	Cause and Analysis	Correction
Steering wheel fails to turn	Oil pump damaged or breakdown	Replace
	Priority valve (Control valve) plugged or damaged	Clean or replace
	Hose (or joint) damaged or pipeline plugged	Clean or replace
Hard to steer	Low pressure on steering overflow valve(located on control valve)	Adjust the pressure
	Air in pipelines	Bleed air
	Controlling pipelines plugged	Clean or replace
	Priority valve (Control valve) malfunction	Check or replace
	Steering reset failed or retaining flat spring broken(or lack of elasticity)	Replace the flat spring
	Severe inner leakage in steering cylinder	Check the piston seal
Abnormal noise	oil level is lower than the standard level	Refill oil
	Suction tube or strainer plugged	Clean or replace
	insufficient lubrication	Smear or fill calcium base grease
	bolts or nuts loosen	fasten
	Adjusting washer of the shaft installed incorrect	Adjust
	Knuckle bearing on both ends of connecting rod damaged	Replace
Running unstably	Wheel nuts loosen	fasten
	Wheel bearing is belonged the adjusting range	Adjust
	Adjusting washer of the shaft installed incorrect	Adjust
Oil leakage	Seal of guide sleeve on steering cylinder damaged or pipelines / connectors damaged.	Replace

Remove Wheel hub

- (1) Jack up and support forklift truck body with wooden blocks.
- (2) Remove tire.
- (3) Remove hubcap.
- (4) Remove steering spindle nut.
- (5) Pull off hub assemblies.
- (6) Remove bearing inner race.



CAUTION

- Not to drop bearing inner race.
- Be careful not to damage oil seal.

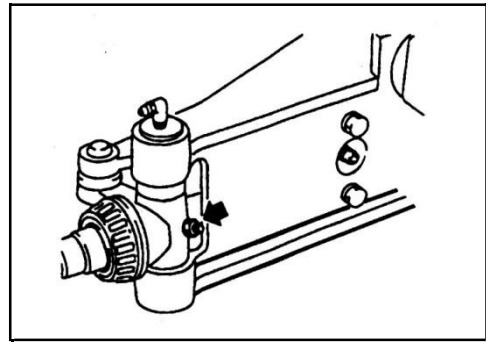


Fig. 2-2

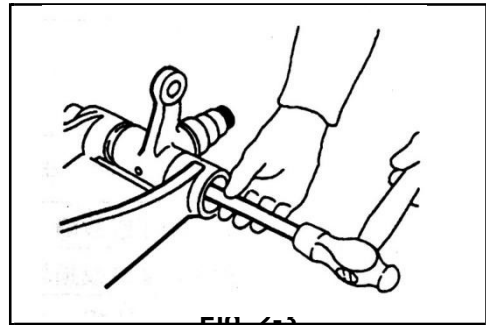


Fig. 2-3

Kingpin and steering spindle

- (1) Remove rod.
- (2) Loose lock bolts. (See fig.2-2);
- (3) Remove grease nipples on kingpin.
- (4) Remove kingpin.



CAUTION

Hold kingpin to prevent it from dropping. (See fig.2-3).

- (5) Take off spindle, thrust bearing and shim.

INSPECTION:

- (1) Replace spindle if cracked.
- (2) Replace bearing if its rollers or roller surfaces are rusted or nicked.
- (3) Replace steel sleeve if it distortion, out of round, cracked.
- (4) Replace thrust bearing and dust cap if them damaged.

Installation

To install, reverse the order of removal. Careful observes the following.

- (1) Always insert kingpin from lower side.
- (2) Install thrust bearing, set the tighten-ring below the support and loosen-ring. Pack all grease between dust proof inside, loosen-ring, and tighten-ring.
- (3) Adjust axial play to specification with shims. Axial plays less than 0.20mm.
- (4) The character of seal tape faces outside. Apple grease to roller of roller bearing, also apply grease between lip and groove of seal tape.

- (5) Pack all grease nipple with a sufficient.

Wheel bearing adjustment

- (1) Slowly rotate hub. Tighten steering spindle nut until it can no longer be rotated with one hand.
- (2) From that position, turn back steering spindle nut $1/6 \sim 1/4$ rotation. Measure hub bolt force is 10~30N.
- (3) Make sure that hub rotates smoothly and that its axial play is within specification. Axial play is less than 0.10mm.

Steering cylinder

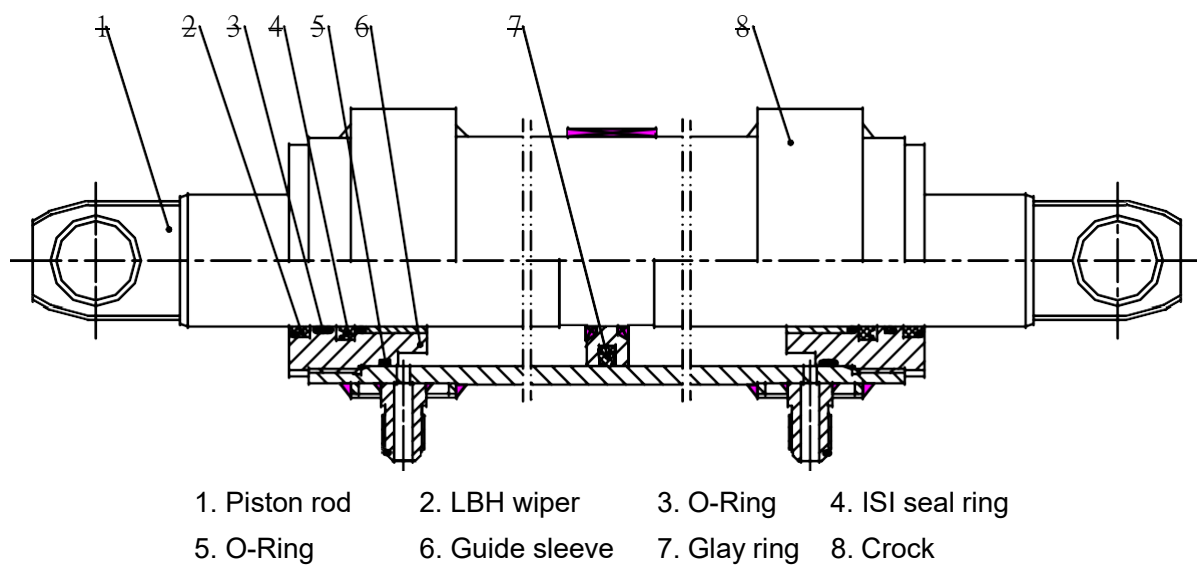


图 2-4 Steering cylinder

3. Brake system

Brake system is composed of service brake and parking brake. Service brake refers to the hydraulic brake depressed on the hydraulic system by foot while parking brake refers to the mechanical brake applied by hand. Both service brake and parking brake function together with the wet disc brake located in the transmission of wheel edges of driving axle.

Foot brake piping system and brake master cylinder

Foot brake piping system and brake master cylinder

Foot brake piping system

The foot brake piping system is composed of oil pot 9, pipeline 7, brake master cylinder, pipelines 12, 14, 15 and tee components, hoops and so on. See Figure 3-1.

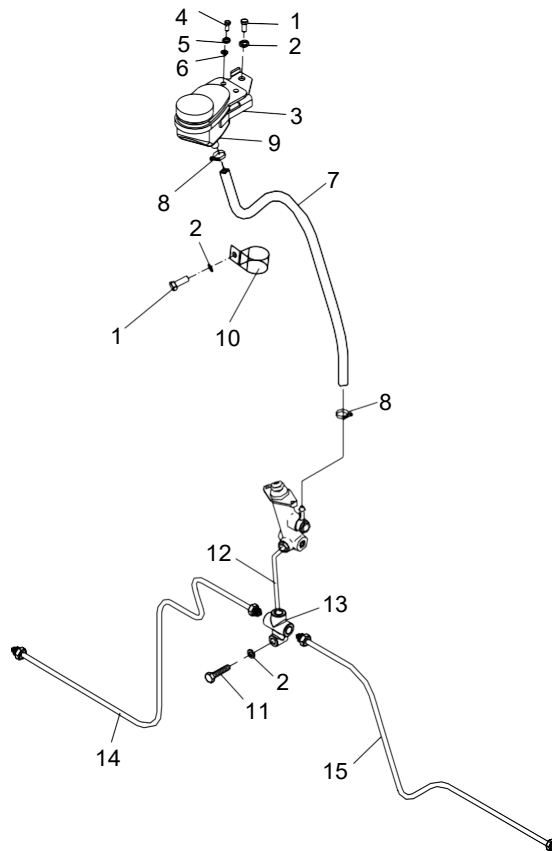


Fig.3-1

The oil pot is located on the left side of the instrument rack, and the oil pot can be seen by opening the cover. DOT3 brake fluid should be added to the oil pot. Check the pipeline for oil leakage every week. If it is insufficient, it should be added in time.

Brake master pump

The master pump contains a valve seat, check valve, return spring, primary cup, piston and secondary cup, which are kept in place with stop washer and stop wire. The exterior of the cylinder is protected against dust by means of a rubber dust cover. The piston is actuated through the push rod by operation of the brake pedal. Once the brake pedal is depressed, the push rod pushes the piston forwards. And the brake fluid in the front cavity of cylinder flows back to the reserve tank through the return port until the primary cup blocks up the return port. After the primary cup passes the return port, the brake fluid in the cylinder is pressurized and opens the check valve, flowing through the brake pipelines to the wheel cylinder. Thus, each wheel cylinder piston is forced outwards. It connects the brake shoes with the wheel drum which slows or stops the lift truck. Meanwhile, the back cavity of the piston is filled with brake fluid led through the return port and inlet port to lubricate the piston. When the brake pedal is released, the piston is forced backward by the return spring. At the same time, the brake fluid in each wheel cylinder is pressurized by the force of the brake shoe return spring, which makes the fluid returning into the master pump (front cavity of the piston) through the check valve. With the piston in original position, the fluid in the cylinder flows into the reserve tank through the return port. Reset the pressure of the check valve to keep it in proportion to the a residual pressure of The brake fluid in the brake lines and wheel cylinders in order to make sure each wheel cylinder piston cup is securely seated to prevent oil leakage and eliminates of vapor lock when the lift truck comes to an emergency stop.

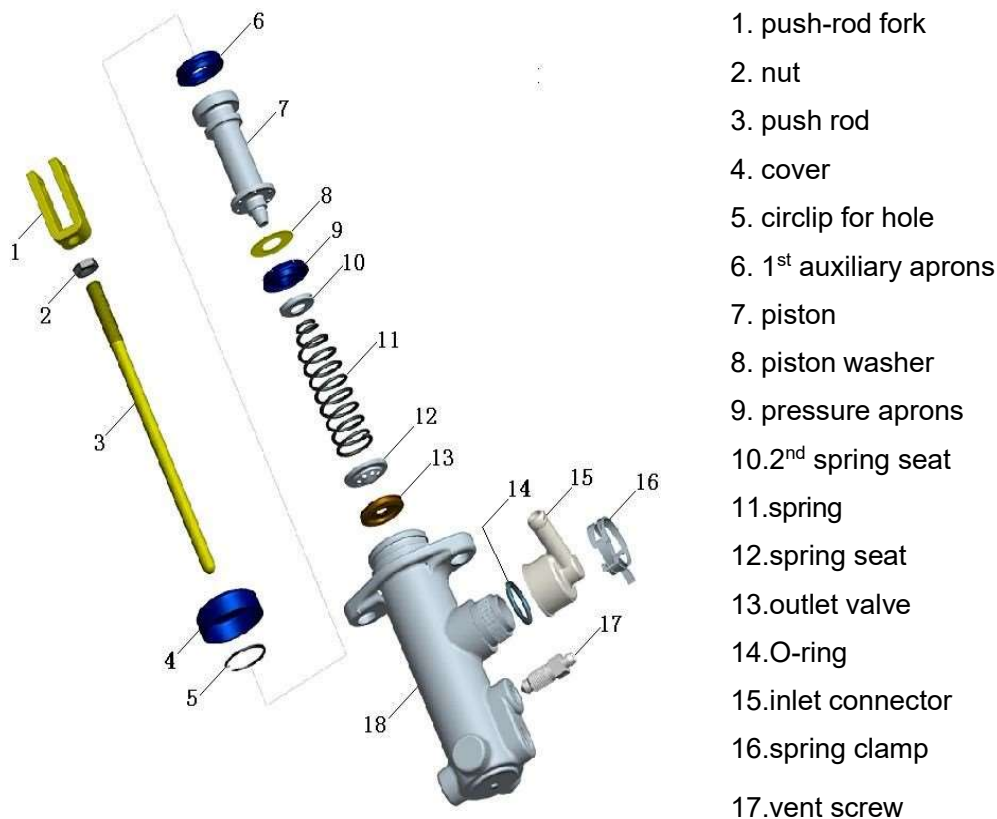


Figure 3-2 Brake Master Pump

Hand brake device

The hand brake device adopts a hand-pulling soft brake wire cable device. It makes use of auto-assist pressure linings type brake together with foot brake. Only when parking truck, use the hand brake. Figure 3-3.

Condition	Cause and Analysis	Correction
Insufficient brake force	Oil leakage in brake lines.	Correct and refill oil
	Air in brake lines.	Bleed air
	Malfunction of master cylinder or wheel cylinder.	Correct or replace
	Oil lines plugged	Clean
Brake dragging	No free Stroke of brake pedal.	Adjust
	Piston cup damage	Replace
	Weak or broken return springs.	Replace
	Returning port of master cylinder plugged	Clean
	Oil lines plugged	Clean

The hand brake device uses a hand-held flexible shaft mechanism that uses an automatic power-assisted shoe brake that acts on the front wheel in conjunction with the foot brake. Use the hand brake only when the forklift is parked.

Before adjusting the hand brake, make sure the axle brake system is functioning properly.

- 1) Adjust nut B so that the length is equal to 68mm, then tighten lock nut B.
- 2) Tighten the adjusting nut A to adjust the hand brake tension. The pulling force is: when the handle is locked, the tension in the Q direction is 147N-196N.
- 3) After the handbrake lever is properly adjusted, release the handbrake lever to ensure that the brake is fully released.
- 4) Through the above adjustments, ensure that the hand brake device works normally.

Note: Apply a proper amount of lithium grease to the guide rail C and keep it applied frequently.

Foot brake

Foot brake structure

1.5t-3.5t Forklift right brake structure3-4。

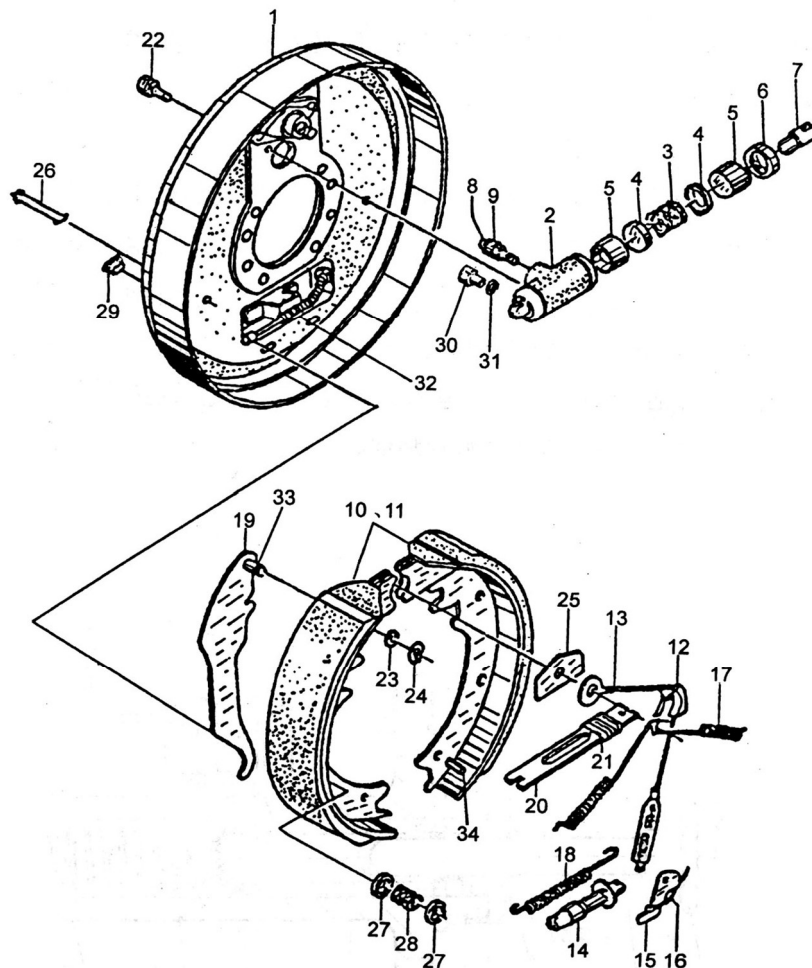


Fig.3-4 1.5t-3.5t forklift truck right brake assy

1. Brake mountbracket	2. Wheel cylinderbody	3. Cylinder return spring
4. Rubber cap	5.Piston	6.Cylinder dustcover
7. Push rod	8.Air bleeder cap	9.Air bleeder screw
10. Brake shoeassy (front)	11. Brake shoe assy (rear)	12. Guider
13. Adjuster cable	14.Adjusting bolt	15. Pawl
16.Spring	17. Brake shoe return spring	18.Return spring
19.Parking brake rod	20.Strut level	21.Spring
22.Bolt	23.Washer	24.Snap ring
25.Guider	26.Spring support rod	27.Spring bracket
28.Spring	29.Plug	30.Oil connector
31.Bush	32.Brake steel cable	

Replace brake shoe

- 1) Place the forklift truck on level concrete.
- 2) Start the forklift and raise carriage about 100mm.
- 3) Place chocks behind rear wheels to prevent movement of forklift truck.
- 4) Loosen wheel nuts two or three turns each.
- 5) Tilt mast fully backward, and place a wooden block under each side of outer mast.



WARNING

- **Do not allow wooden blocks to touch front tires.**

- 6) Tilt mast forward until front tires are raised from surface.



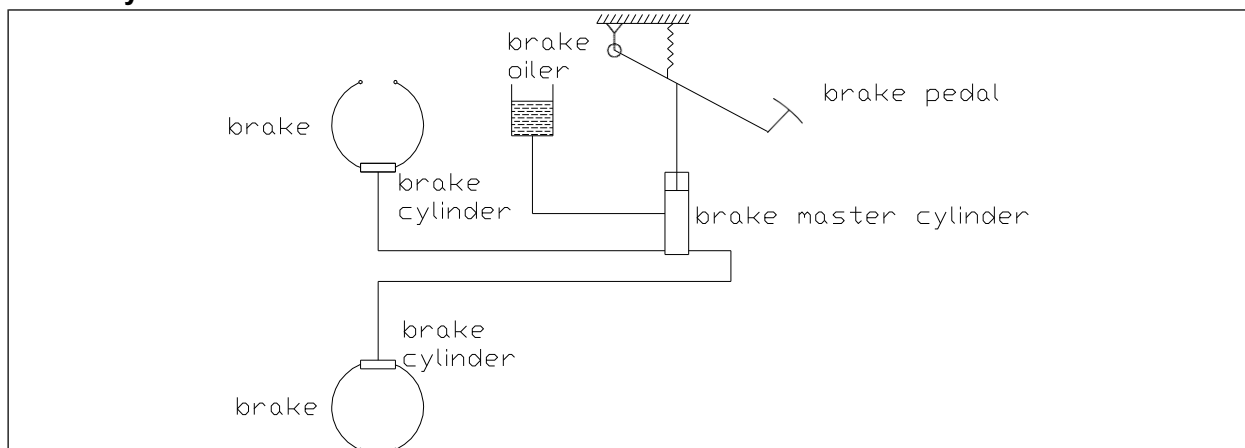
CAUTION

Remove the wheel nuts after the front wheels are raised from the ground.

- 7) Support forklift truck by putting additional wooden blocks under each side of front-end frame.
- 8) Stop the forklift.
- 9) Remove wheel tire nuts and brake drum.
- 10) Replace brake shoes with new ones.
- 11) Install brake drum.
- 12) Adjust shoe to drum clearance:
 - a. Remove adjusting hole plug on the bottom of the brake assembly.
 - b. Insert a flat-blade screwdriver to adjusting hole, turn adjusting ratchet wheel downward to expand the brake shoes until wheel hub can not be turned by hand.
 - c. Move the ratchet wheel 2~3 notches to allow the wheel hub to be turned freely, slight friction is allowed between the brake and shoe lining.
 - d. Replace the plug.
 - e. Install wheels.
 - f. Properly adjusting pedal stroke.
 - g. Remove blocks.

make sure no person or obstacle is around forklift, then operate forklift in reverse at 2 to 3 km/h, set foot on brake pedal 2~3 times.

Brake system schematic



Schematic diagram of drum brake principle

4. Hydraulic system

The high pressure oil from main pump goes to control valve and divide it to two parts by dividing valve inside control valve: one of them goes to lifting cylinder or tilting cylinder, another part goes to steering gear with invariable flow to control steering cylinder. When lifting and tilting spool is in neutral, high pressure oil return oil tank directly from pass way. When pulling lifting spool, high pressure oil goes by throttle valve and then push piston rod under lifting cylinder piston. When pushing lifting spool, it is that bottom of lifting cylinder piston connects with low pressure line and then piston rod drops by deadweight and weight of cargo. In this time, oil from lifting cylinder goes by unidirectional speed limiting valve so as to control the falling speed. When operating tilting spool, high pressure oil goes to front house of tilting cylinder and another connects with low pressure line so as to make mast tilt forward or backward.

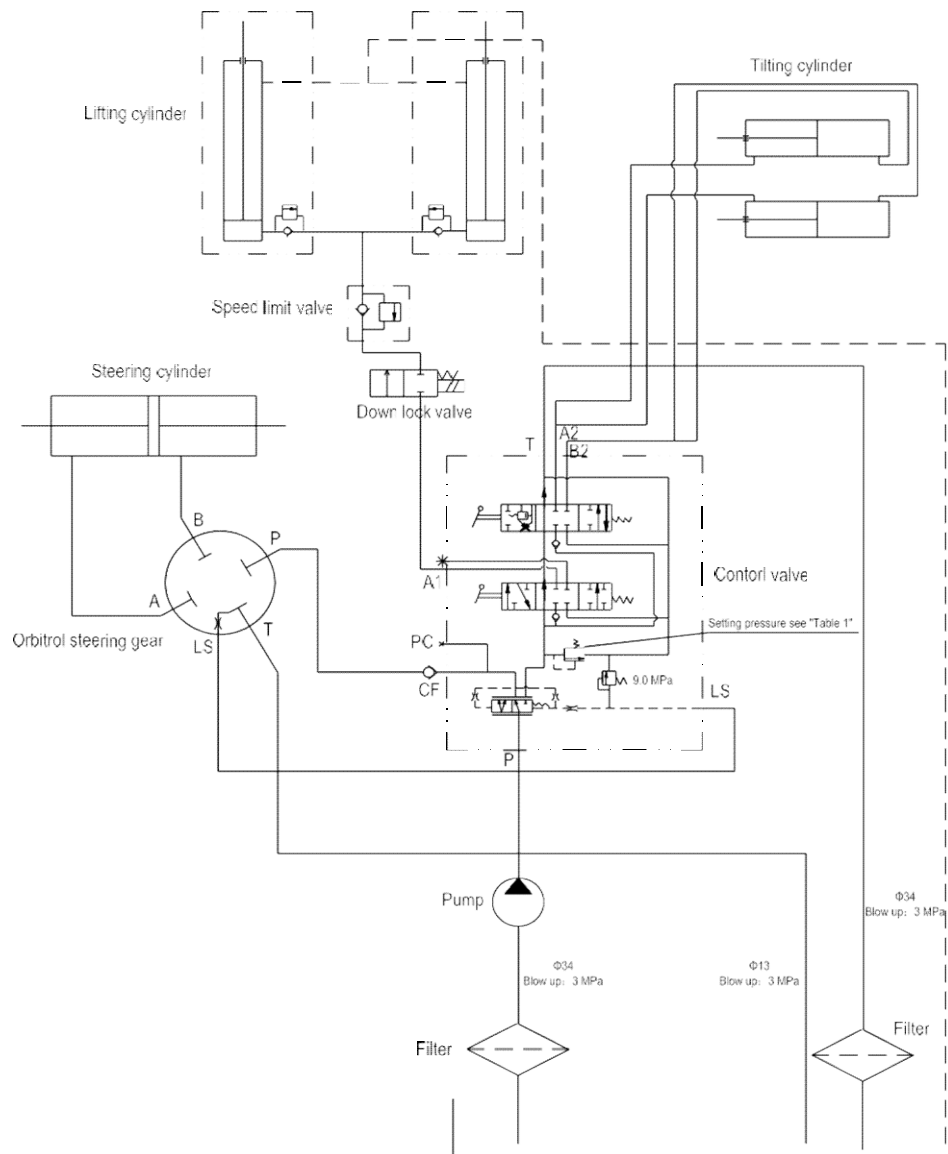


Table 1

Tonnage:t	1.0	1.5	1.8	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Setting pressure:MPa±0.5MPa	12.0	15.0	17.4	17.5	17.6	17.7	17.8	18.3	18.5	18.9

Fig.4-1 Hydraulic System Diagram

Main pump

Trouble	Probable cause	Corrective action
No oil from oil pump	Low oil level in tank.	Add oil to specified level.
	Clogged suction pipe or strainer.	Clean oil line and tank. If oil is dirty, change.
Low discharge pressure on oil pump.	Worn bearing damaged backup ring and O-ring.	Replace faulty parts.
	Maladjusted relief valve.	Readjust to specified pressure using pressure gauge.
	Air in oil pump.	Retighten suction side pipe.
		Add oil in oil tank.
		Check pump oil seal.
		Do not operate pump until bubbles in tank disappear.
Noisy oil pump	Cavitation due to crushed suction hose or clogged strainer.	Adjust or replace crushed hose and clean strainer.
	Air being sucked from loose suction side joint.	Retighten each joint.
	Cavitation due to too high oil viscosity.	Replace with new oil having proper viscosity for temperature at which pump is to be operate.
		To operate when oil temperature is normal.
	Bubbles in hydraulic oil.	Determine cause of bubbles and remedy.
Oil leaking from oil pump	Faulty oil seal on pump, faulty O-ring or worn sliding surfaces on pump.	Replace faulty parts.

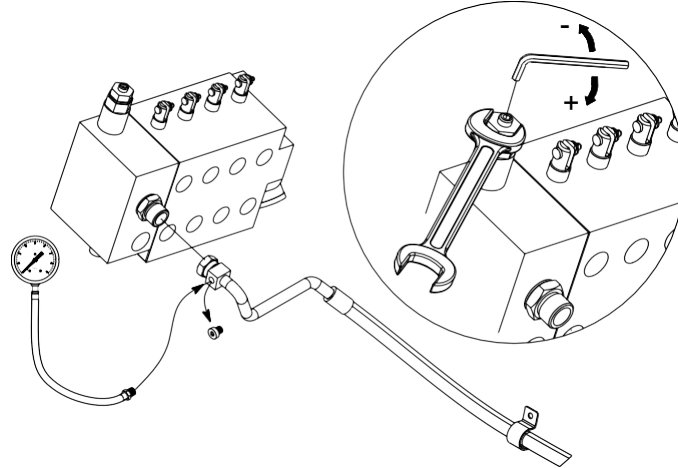
Control valve

Trouble	Probable cause	Corrective action
Pressure of relief valve is not steady or too low.	Loose of pressure-adjust screw.	Readjusted and retighten.
	Distorted or damaged pressure-adjust spring.	Replace.
	Worn or blocked relief valve core.	Replace or clean.
	Pump abated.	Examine and repair pump.
Fork tilt forward when control lever is used while engine is off.	Worn or damaged tilt lock valve.	Replace valve core and tilt lock valve as an assembly.
	Broken tilting lock spring.	Replace spring.
	Damaged tilt valve plunger O-ring.	Replace O-ring.
Mast is unstable when tilting forward.	Malfunctioning tilt relief valve.	Replace tilt relief valve assembly.
Lowering distance of mast is big when spool valve is in the centre.	Valve body and spool valve is worn and clearance between them is too great.	Replace spool valve with specified clearance.
	Spool valve is not in centre.	Keep being in the centre.
	Cylinder seal abated.	Examine and repair cylinder.
	Taper valve is worn or blocked by dirt.	Replace or clean taper valve.
Spool valve is not return neutral position.	Damaged or distorted reposition-spring.	Replace spring.
	Dirt exist between valve body and spool valve.	Clean.
	Blocked control device.	Adjusted.
	Not coaxial parts at reposition	Reinstall., be coaxial
Leakage	Damaged O-ring.	Replace.
	Faulty seal of joint.	Check and retighten.
	Loose seal plate.	Clean seal plate and retighten bolts.
	Loosed lock-nut of relief valve and connect-nut between plate and plate.	Tighten.
Multi-way valve cannot move back and forth	Multi-way valve moves back and forth to adjust handle interference	Adjustment

Adjusting the pressure of the main relieve valve

The main relieve valve has been adjusted before leaving the factory, , it is not allowed to adjust at will in general condition. Adjusting way is as follows:

- (1) Park the truck on solid and smooth road, place in neutral, pull up the hand brake handle, tilt the mast backwards to the end, and drop the fork to the ground. The engine stops.
- (2) Open front soleplate, release the pressure mouth bolt of oil inlet pipeline in the multi-way valve, and put in clean place. If hydraulic oil outflows, please protect the environment.



- (3) Connect the pressure gauge. Notice: a. Specification of gauge should be larger than 20Mpa. b. taper thread at pressure mouth matches: Rc1/8R1/8; c. tightening torque is 20-22N•m.
- (4) Start the engine, place the mast in vertical, and the fork is 300mm from the ground.
- (5) Read out the indication in the pressure gauge, and judge is the main safety valve of multi-way valve is in normal scope.
1. 0t, 1. 5t: 15. 0MPa $\pm$ 0. 5 MPa, 1. 8t~3. 5t: 18. 5MPa $\pm$ 0. 5 MPa
- (6) If the pressure is not in the normal scope, please release the main safety valve lock nut, and adjust adjusting bolt.
If the indication is smaller than the normal scope, inner hexagon spanner the adjusting bolt in clockwise (+) to increase main safety valve pressure.
If the indication is larger than normal scope, inner hexagon spanner the adjusting bolt in counterclockwise (-) to decrease main safety valve pressure.
- (7) Stable the pressure in normal scope for 30's.
- (8) Release pressure gauge, install the bolt, and the tightening torque is 20-22N•m. Drop the mast to the ground and tilt backward to end.
- (9) Retighten the tightening nut, and fix it on the front soleplate.

5. Lifting system

Data

Inspection and adjustment

Place		Assly clearance	Repair clearance
Mast to lift roller	mm	0.1~0.8	0.2~1.0
Shims	mm	0.5 / 1.0 / 2.0	
Mast to back up metal	mm	0.1~0.8	0.2~1.0
Shims	mm	0.5 / 1.0 / 2.0	
Inner mast to carriage side roller	mm	0.1~0.6	0.2~1.0
Shims	mm	0.5 / 1.0 / 1.5	
Lift chain deflection	mm	25~30	

Tightening torque

Place	N·m
Lift chain lock nut	127~157 (M16), 176~216(M18), 245~314 (M20)
Mast support cap blot	89~118 (M14), 176~216 (M18)
Tilt cylinder lock nut	89~118 (M8)
Lift cylinder bolt(head)	76~107 (M12)
Lift cylinder bolt (toe)	22~29 (M8), 44~58 (M10)
Lift cylinder fixing bolt (U type)	14~18 (M8), 29~39 (M10)

Fault

Fault	Probable cause	Corrective action
Fork arm carrier or mast tilt by itself.	Tilt cylinder and ring abraded excessively	Replace piston ring tilt cylinder.
	The hydraulic control valve spring is inoperative.	Replace it.
The fork arms carrier moves up and down sluggishly.	Caused by piston jamming or bent piston rod.	Replace the faulty parts.
	Too much dirt is accumulated in the cylinder.	Strip it down and clean.
Forks are lifted or lowered unsmoothly.	Carriage bracket assembly out of adjustment.	Adjust clearance with thrust metal and carriage side roller.
	Insufficient clearance between inner and outer masts or rollers and mast.	Adjust clearance with rollers.
	Biting foreign materials between moving part.	Remove foreign materials.
	Insufficient lubrication.	Apply grease on contact surfaces of sliding parts. (butter)
	Bent carriage bracket assembly.	Repair or replace.
Forks are lifted unevenly	Lift chains out of adjustable.	Adjust lift chains.
Lift roller does not rotate	Grease stiffened or dirt accumulated on lift roller and mast sliding surfaces.	Clean and lubricate lift rollers.
	Improperly adjusted lift roller.	Adjust.
Excessive mast noise	Insufficient lubrication.	Lubricate.
	Improperly adjusted lift roller, side roller and back-up metal.	Adjust.
	Rubber pad on lower of outer mast is useless for container fork lift truck.	By adjusting shims and rubber pad, piston rod is in touch with bottom of cylinder body after inner mast is in touch with rubber pad.
Insufficient lift power or no lift movement.	Excessive wear occurs between the oil pump body and gears, causing too much clearance.	Replace the worn parts or the oil pump.
	The lifting jack piston Yx-ring has worn, resulting in excessive inner leaks.	Replace Yx-ring.
	Springs of the multiple control valve and its relief valve are inoperative oil leaks.	Replace.
	Excessive wear occurs of the hydraulic control valve ,resulting in excessive oil leaks.	Replace
	Oil leaks occur between the hydraulic control valve sections.	Dismantle for regrinding the joint surfaces and reassemble the valve.
	Leakage occurs in the hydraulic pipe.	Tighten the joint nuts and inspect the seal for damage.
	The hydraulic oil temperature is too high. Oil viscosity is too low and the rate is insufficient.	Change the wrong hydraulic oil or stop operation for reducing the oil temperature. Find out the reasons for high oil temperature and eliminate the trouble.
	The load carried is beyond the designed capacity.	Observe the lifting capacity limit.

Mast

Basic mast is 3m high, composed of inner and outer mast, fork arm carrier, fork arm, chain and idler wheel, etc.

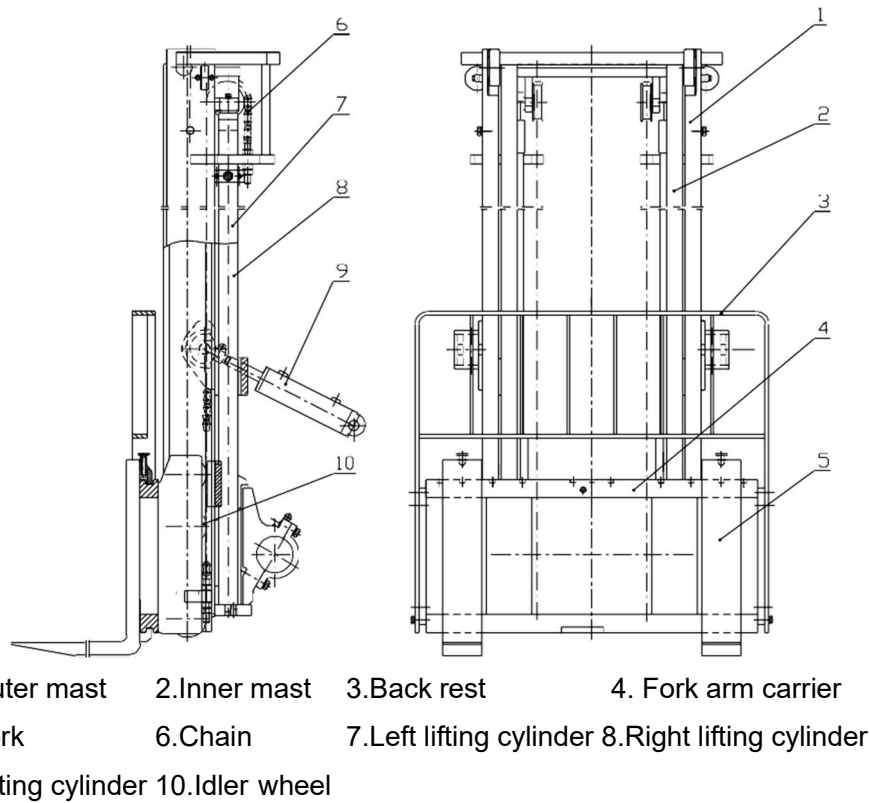


Fig5-1 Double lift mast with wide view

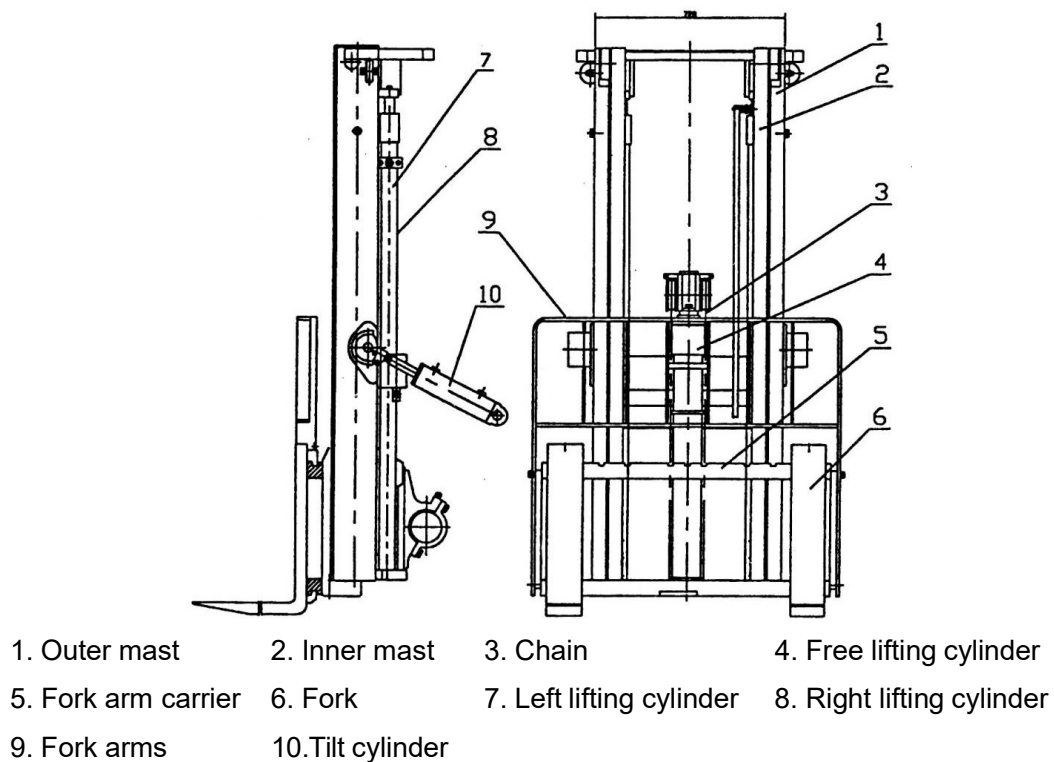
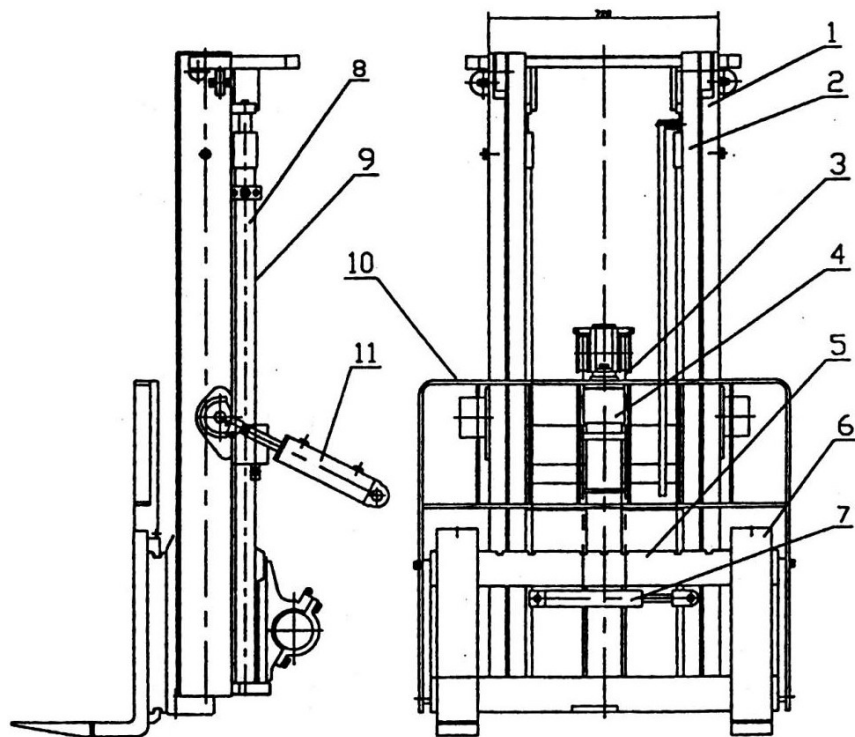
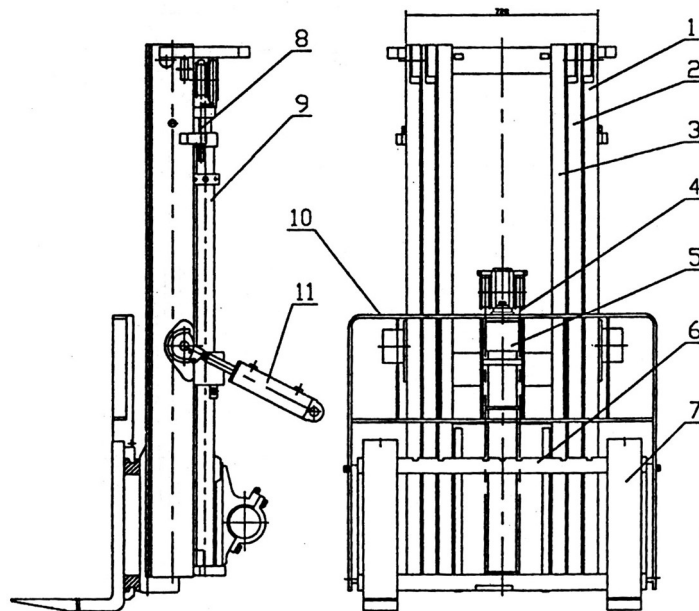


Fig5-2 Double full free lift mast



- | | | | |
|------------------------|---------------|---------------------|--------------------------|
| 1. Outer mast | 2. Inner mast | 3. Chain | 4. Free lifting cylinder |
| 5. Fork arm carrier | 6. Fork | 7. Sideway cylinder | 8. Left rise cylinder |
| 9. Right rise cylinder | 10. Fork arms | 11. Tilt cylinder | |

Fig 5-3 Container truck mast

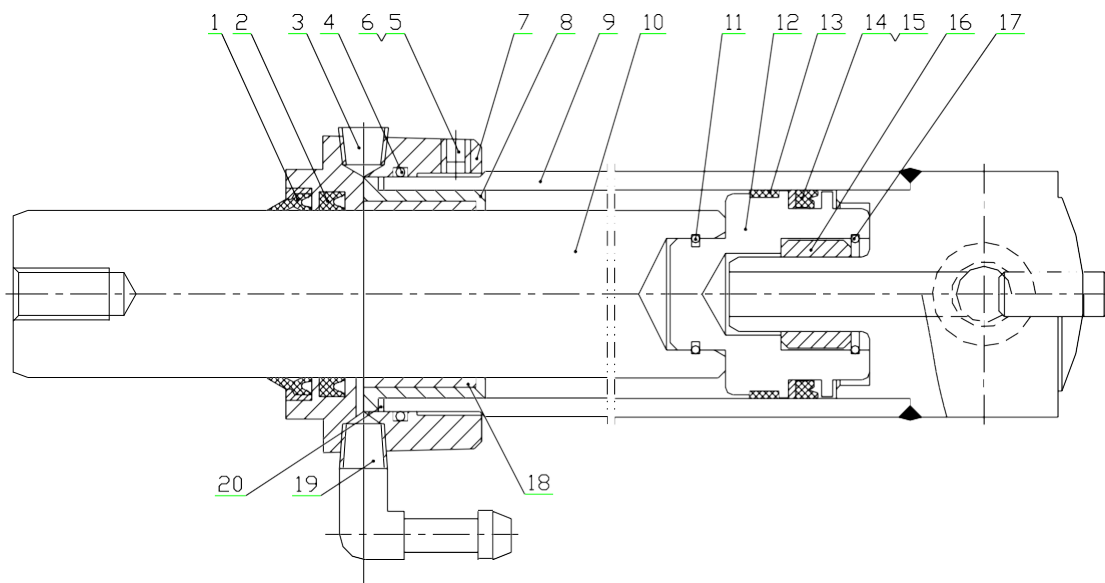


- | | | | |
|------------------------|---------------|---------------------|--------------------------|
| 1. Outer mast | 2. Inner mast | 3. Chain | 4. Free lifting cylinder |
| 5. Fork arm carrier | 6. Fork | 7. Sideway cylinder | 8. Left rise cylinder |
| 9. Right rise cylinder | 10. Fork arms | 11. Tilt cylinder | |

Fig 5-4 Triple full free lift mast

Lifting cylinder

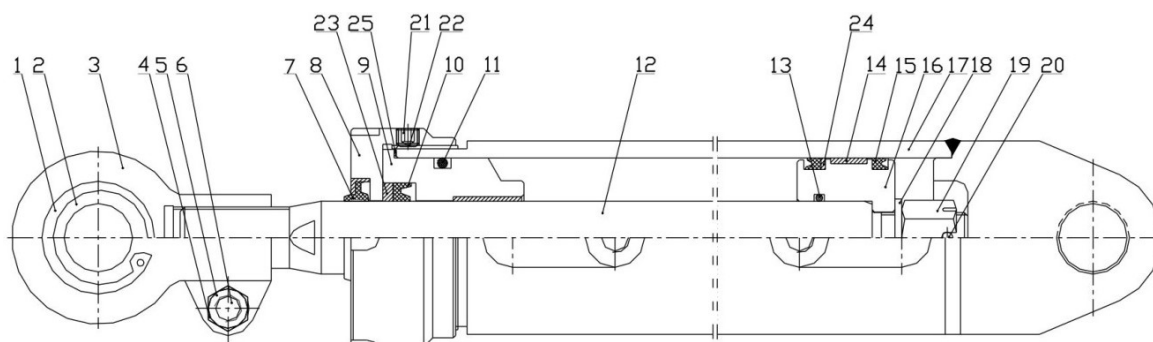
Plunger feeder lifting cylinder has dash control, configuration see fig 5-5.



- | | | | |
|------------------|--------------------|------------------|---------------------|
| 1.LBH dust proof | 2. ISI ring | 3. Plug screw | 4. O Ring |
| 5.Piston | 6.Bolt | 7.Guide | 8.bush |
| 9. Cylinder body | 10.Piston | 11. Snap ring | 12. Piston |
| 13. Support ring | 14. Back up rings | 15. OSI ring | 16. Valve guide |
| 17.Snap ring | 18. Steel axletree | 19.Blowout patch | 20.Adjusting washer |

Fig 5-5 Lifting cylinder

Tilting cylinder



- | | | | | |
|-------------------|--------------------|---------------|-----------------------|---------------------|
| 1. Retaining ring | 2. Knuckle bearing | 3. Support | 4. Lubrication nipple | 5. Nut |
| 6. Bolt | 7. Dust proof | 8. Cylinder | 9. Guide | 10. U ring |
| 11.O-Ring | 12.Piston rod | 13. O-Ring | 14.Thimble | 15.U ring |
| 16.Piston | 17.Cylinder body | 18. Washer | 19.Nut | 20.Pin |
| 21.bolt | 22.Nylon tray | 23. Snap ring | 24.Snap ring | 25.Adjusting washer |

Fig 5-6 Tilting cylinder

6. Electrical system

Controller

MC3336-A850 Low voltage AC controller

MC3336 series low-voltage AC controller is a driver used in low-voltage AC electric counterbalanced forklifts. Compared with the DC motor drive system, the AC drive system can achieve a wider range of motor speed regulation, thereby increasing the driving speed of the vehicle; the AC motor has no carbon brush, is fully enclosed, maintenance-free, and the system reliability is greatly improved; the AC system can reach higher efficiency and realize flexible energy feedback control, thereby effectively increasing the driving range.

MC3336 series low voltage AC controller has the following characteristics:

- Use DSP as the main control chip to establish a good platform for realizing motor control algorithms.
- The use of high-power MOSFET tubes as power devices shows low-noise and high-efficiency energy conversion.
- Adopt advanced vector control algorithm to realize the precise control of the motor torque and speed by the controller.
- Braking or reverse energy feedback control to increase the driving range of the vehicle.
- Anti-rollover function on slope to improve driving safety.
- The parameters can be flexibly adjusted to adjust the handling performance of the vehicle to meet the requirements of different road conditions and various use environments.
- The buzzer prompts various faults for easy maintenance.
- Complete protection functions such as accelerator failure, undervoltage, overvoltage, overcurrent, and overheating enhance the reliability of the system.
- CAN bus communication.
- The software can be customized according to the different needs of different users to meet the individual needs of customers.
- The maximum speed control of vehicle is improved obviously by load compensation.

Technical parameters of MC3336 series low voltage AC controller

Technical data and performance		
Product specifications		MC3336-A850
		80V system
Electrical performance	Input voltage range (DC/V)	60~108
	Maximum output current (AC/A)	500
	Rated output current (AC/A)	120
	Controller starting voltage (DC/V)	50
	Controller starting voltage (DC/V)	50
Working environment temperature range		-30℃-----55℃
Protection level		IP65
IP65		Input and output to the case DC1000V leakage current 0.05mA, insulation resistance 20MΩ
Storage environment temperature range		-40℃-----70℃
Efficiency		98%
Cooling method		Natural cooling
Vibration standard		GB/T2423
Motor control method		Vector control with speed sensor
Communication mode		CAN communication
Weight		5kg
Heat dissipation requirement		The controller must be installed in a well-ventilated place, otherwise forced air cooling is required

MC3336 系列低压交流控制器故障代码

No.	Description	Warning method	Treatment method	Troubleshooting
01	High pedal fault	Ring long	Shut down	Check the pedal and return it
02	Power tube straightway conduction fault	One long and three short	Shut down	Return to factory for repair
03	Current sensor zero drift fault	One long and six short	Shut down	Return to factory for repair
04	Battery pack undervoltage	One long and nine short	Shut down	Need to charge
05	attery pack overvoltage	One long and ten short	Shut down	Check whether the battery is normal and appropriately reduce the energy feedback.
06	Accelerator pedal fault	One long and thirteen short	Shut down	Check pedal signal, pedal wiring harness
07	Encode fault	One long and seven short	Shut down	Check the encoder signal and encoder wiring harness.
08	Current sampling circuit failure	One long and twenty-two short	Shut down	Return to factory for repair
09	Hardware overcurrent	One long and twenty-three short	Shut down	The first step is to adjust the control parameters, the second step is to adjust the output torque, if the problem cannot be solved, return to the factory for repair
10	Controller overheated	Report fault code	Torque derating	Check whether the fan works normally and whether the air duct is smooth.
11	Motor overheated	Report fault code	Torque derating	Check whether the motor heat dissipation works normally.
12	Phase current software overcurrent	Report fault code		Appropriately reduce torque output
13	Motor overspeed	Report fault code	Perform zero torque	Check the motor speed limit setting
14	Motor blocked	Report fault code	Torque reduced to 50% of maximum torque	Check whether there is a stall condition
15	MCU feedback torque and MCU feedback torque and	Report fault code	Perform zero torque	Check whether the torque command and actual torque are abnormal
16	Motor temperature sensor failure	Report fault code	Torque reduced to 50% of maximum torque	Check whether the motor temperature sensor is normal
17	Controller temperature sensor failure	Report fault code	Torque reduced to 50% of maximum torque	Check whether the controller temperature sensor is normal
18	BusOff fault	Report fault code		Power on again
19	I2C Verification failure	Report fault code		Power on again

ACM48 AC controller

Main technical parameters

No.	Item	Technical parameters
1	Applicable motor type	AC asynchronous motor, AC synchronous motor
2	Communication mode	CAN
3	Operating frequency	8kHz
4	Stator working frequency	0~300Hz
5	Rated voltage	48V
6	Operating voltage range	25.2V~60V
7	Control mode	Speed (rpm), torque (Nm), current Arms or DC voltage (Vdc)
8	Interface form	AMP SEAL 35-pin
9	Operating temperature	-20~95℃ (between 85℃~95℃, the output current is reduced linearly)
10	Working temperature	-20~50℃
11	Storage temperature	-40~95℃, the maximum environmental humidity is 95%RH
12	Waterproof and dustproof grade	IP65
13	Weight	2.8kg
14	Dimension (L*W*H)	200mm*150mm*78mm
15	Mounting bolt tightening torque	13±2Nm
16	Design life	≥20000h
17	Standard compliance	EN12895, EN1175, EN (ISO) 13849-1

Controller fault list

Code No.	Fault classification	Fault name	Description	Influence
1	Power level	Hardware overcurrent trigger	One over-current or short-circuit fault occurs, restart	Breakdown
2	Power level	Hardware overcurrent	Hardware watchdog stops working and restarts	Breakdown
3	Current sampling	Current reference offset failure	The motor reference is offset, it is recommended to restart or replace	Breakdown
4	Current sampling	Software overcurrent	U phase V, W phase continuous over-current, restart	Breakdown
5	Current sampling	Software overcurrent trigger	One over current fault of software	Breakdown
6	Current sampling	Software gain error	Abnormal software gain data	Breakdown
7	Motor speed	Speed limit	Motor speed is limited	Alarm
8	Motor speed	Over speed	Motor speed exceeds the set value	Breakdown
9	Motor speed	High motor speed	High motor speed	Alarm
10	Motor speed	Low motor speed	Motor speed is low	Alarm
11	Motor	Brake fault	Motor brake curve error	Breakdown
12	Motor	Slip fault	Unpredictable slip	Breakdown
13	Motor	Motor is not connected	Motor is not connected	Breakdown
14	Bus	Hardware bus overvoltage	Hardware bus voltage is too high	Breakdown
15	Bus	Bus overvoltage warning	Bus voltage is too high, limiting torque	Alarm, derated operation
16	Bus	Software bus overvoltage	Software bus voltage is too high	Breakdown
17	Bus	Bus undervoltage warning	Bus voltage is too low, limiting torque	Alarm
18	Bus	Software bus undervoltage	Software bus voltage is too low	Breakdown
19	Bus	Bus charging time out	Bus charging time is too long	Failure, the machine does not start
20	Bus	Bus gain error	Bus sampling gain error	Failure, the machine does not start
21	Radiator temperature	Radiator temperature sampling open circuit	Radiator temperature sampling open circuit	Alarm, slow shutdown
22	Radiator temperature	Radiator temperature sampling short circuit	Radiator temperature sampling short circuit	Alarm, slow shutdown

Code No.	Fault classification	Fault name	Description	Influence
23	Radiator temperature	Radiator temperature sampling high alarm	Radiator temperature sampling is too high, current limit	Alarm, derated operation
24	Radiator temperature	Radiator temperature sampling high alarm	Radiator temperature sampling is too high	Breakdown
25	Radiator temperature	Radiator temperature sampling low alarm	Radiator temperature sampling is too low	Alarm, derated operation
26	Radiator temperature	Low radiator temperature sampling	Radiator temperature sampling is too low	Breakdown
27	Motor temperature	Motor temperature sampling open circuit	Motor temperature sampling open circuit	Alarm, slow shutdown
28	Motor temperature	Motor temperature sampling short circuit	Motor temperature sampling short circuit	Alarm, slow shutdown
29	Motor temperature	Motor temperature sampling high alarm	Motor temperature sampling is too high, current limit	Alarm, derated operation
30	Motor temperature	Motor temperature sampling high alarm	Motor temperature sampling is too high	Breakdown
31	Motor temperature	Motor temperature sampling low alarm	Motor temperature sampling is too low	Alarm, derated operation
32	Motor temperature	Low motor temperature sampling	Motor temperature sampling is too low	Breakdown
33	Ambient temperature	Ambient temperature sampling open circuit	Motor temperature sampling open circuit	Alarm, slow shutdown
34	Ambient temperature	Ambient temperature sampling short circuit	Motor temperature sampling short circuit	Alarm, slow shutdown
35	Ambient temperature	Ambient temperature sampling high alarm	Motor temperature sampling is too high, current limit	Alarm, derated operation
36	Ambient temperature	Ambient temperature sampling high alarm	Motor temperature sampling is too high	Breakdown

Code No.	Fault classification	Fault name	Description	Influence
37	Ambient temperature	Ambient temperature sampling low alarm	Motor temperature sampling is too low	Alarm, derated operation
38	Ambient temperature	Low ambient temperature sampling	Ambient temperature sampling is too low	Breakdown
39	Speed feedback	Encode fault	Speed change rate is greater than 1000RPM/20ms	Breakdown
40	Speed feedback	Encode alarm	Encoder speed high warning	Breakdown
41	Speed feedback	Encoder resolution failure	Speed is greater than 15000RPM	Breakdown
42	Speed feedback	Phase A is missing	Encoder phase A is missing	Breakdown
43	Speed feedback	Phase B is missing	Encoder phase B is missing	Breakdown
44	High power output	High power output 1 short circuit	Hardware overcurrent	Stop output
45	High power output	High power output 1 open circuit	High power output current is too low	Stop output
46	High power output	High power output 1 short circuit	Software overcurrent	Stop output
47	High power output	High power output 1 output short circuit	High power output current is greater than 200mA	Stop output
48	High power output	High power output 2 short circuit	Hardware overcurrent	Stop output
49	High power output	High power output 2 open circuit	High power output current is too low	Stop output
50	High power output	High power output 2 short circuit	Software overcurrent	Stop output
51	High power output	High power output 2 output short circuit	High power output current is greater than 200mA	Stop output
52	High power output	High power output 3 short circuit	Hardware overcurrent	Stop output
53	High power output	High power output 3 open circuit	High power output current is too low	Stop output
54	High power output	High power output 2 short circuit	Software overcurrent	Stop output
55	High power output	High power output 2 output short circuit	High power output current is greater than 200mA	Stop output

Code No.	Fault classification	Fault name	Description	Influence
56	High power output	High power output short circuit	Hardware short-circuit fault	Stop output
57	High power output	High power output overcurrent	Software overcurrent fault	Stop output
58	High power output	High power output instantaneous overcurrent	Software overcurrent fault	Alarm
59	High power output	High power output abnormal power failure	High power output abnormal power failure	Stop output
60	CAN communication	PDO1 time out	PDO1 time out	Breakdown
61	CAN communication	PDO2 time out	PDO2 time out	Breakdown
62	CAN communication	PDO3 time out	PDO3 time out	Breakdown
63	CAN communication	PDO4 time out	PDO4 time out	Breakdown
64	CAN communication	Synch time out	Synch time out	Breakdown
65	CAN communication	Mapping error	Mapping error	Communication failure, do not start
66	CAN communication	SDO1 time out	SDO1 time out	Breakdown
67	CAN communication	SDO2 time out	SDO2 time out	Breakdown
68	CAN communication	SDO1 busy	SDO1 busy	Breakdown
69	CAN communication	SDO2 busy	SDO2 busy	Breakdown
70	CAN communication	Communication 1 time out	Communication 1 time out	Breakdown
71	CAN communication	Communication 2 time out	Communication 2 time out	Breakdown
72	CAN communication	Communication 3 time out	Communication 3 time out	Breakdown
73	CAN communication	Communication 4 time out	Communication 4 time out	Breakdown
74	CAN communication	CAN lost connection	CAN lost connection	Breakdown
75	System	EEPROM factory reset error	EEPROM factory reset error	Breakdown
76	System	EEPROM check error	EEPROM check error	Breakdown
77	System	Hardware watchdog failure	Hardware watchdog failure	Breakdown
78	System	2ms timer error	2ms timer error	Breakdown
79	System	20ms timer error	20ms timer error	Breakdown
80	System	100ms timer error	100ms timer error	Breakdown

Code No.	Fault classification	Fault name	Description	Influence
81	Internal power supply	15V Power overrun	15V Power overrun	Breakdown
82	Internal power supply	5V Power overrun	5V Power overrun	Breakdown
83	Internal power supply	3.3V Power overrun	3.3V Power overrun	Breakdown
84	Internal power supply	5VA Power overrun	5VA Power overrun	Breakdown
85	Application	Key switch voltage low	Key switch voltage low	Breakdown
86	Application	Analog power supply error	Analog power supply is out of range	Breakdown
87	Application	Analog power supply internal short circuit	Analog power supply internal short circuit	Breakdown
88	Application	+12V Power supply open circuit	+12V power supply without connecting peripherals	Breakdown
89	Application	+12V Power supply short circuit	+12V power supply short circuit	Breakdown
90	Application	+12V Power supply overrun	+12V supply voltage exceeds range	Breakdown
91	Application	+12V gain error	+12V gain error	Breakdown
92	Application	Seat switch error	Seat switch error	Breakdown
93	Application	Activate when the acceleration switch is activated	Activate when the acceleration switch is activated	Breakdown
94	Application	Activate when the direction switch is activated	Activate when the direction switch is activated	Breakdown
95	Application	The front and rear direction switches are activated at the same time	The front and rear direction switches are activated at the same time	Breakdown
96	Application	Accelerator pedal input value exceeds limit	Accelerator pedal input value is out of limit or not connected	Breakdown
97	Application	The accelerator pedal switch is off and there is an input value	The accelerator pedal switch is off and there is an input value	Breakdown
98	Application	Brake analog error	The brake pedal input value exceeds the limit or is not connected	Breakdown
99	Application	The brake pedal switch is off and there is an input value	The brake pedal switch is off and there is an input value	Breakdown
100	Application	Handbrake error	When the handbrake switch is enabled, there is an accelerator pedal analog value	Breakdown

Code No.	Fault classification	Fault name	Description	Influence
101	Application	The driver leaves	The driver leaves and the handbrake is closed and the main contactor is disconnected after 2 minutes	Breakdown
102	Application	Steering input value exceeds limit	The steering input value exceeds the limit or is not connected	Breakdown
103	Application	Lift failure	The side shift switch is activated when the machine is turned on	Breakdown
104	Application	Tilt failure	The tilt switch is activated when the machine is turned on	Breakdown
105	Application	Side shift failure	The side shift switch is activated when the machine is turned on	Breakdown
106	Application	Lifting analog	Lifting analog quantity exceeds range	Breakdown
107	Application	Lifting switch error	Lifting analog quantity without switch quantity	Breakdown
108	Application	Traction energy limitation	Traction energy limitation	Alarm, limited energy operation
109	Application	Pump energy limitation	Pump energy limitation	Alarm, limited energy operation
110	Application	Battery voltage is too low	Battery voltage is lower than 15%, limited energy	Alarm, limited energy operation
111	Application	Battery voltage is too high	Battery voltage is too high	Breakdown
112	Application	Battery current is too high	Battery current is too high	Breakdown
113	Application	Battery is charging	Battery is charging	Breakdown
114	Application	BMS Temperature protection	BMS Temperature protection	Breakdown
115	Application	High battery temperature	Battery over discharge	Breakdown
116	Application	Battery voltage is too high	Battery voltage is too high	Breakdown
117	Application	Default		
118	Application	Watchdog fault from MCU	Watchdog fault from MCU	Breakdown
119	Application	CAN overvoltage	CAN connected to high voltage	Breakdown

Inmotion Controller

Summarize

International advanced closed-loop system and the advanced control technology are integrated in the controller. Large screen clearly displays common messages as “power”, “speed”, “total running hours”, “drive working time”, “lifting working time” and etc. Faults displayed by codes improve the efficiency of maintenance. The peripheral components can also be detected by the meter, and the functions of the handheld unit can be realized by the meter.

(1) Actuating motor

The drive motor adopts a three-phase AC variable frequency motor with high power conversion rate, no commutator and brush, and realizes maintenance-free.

(2) Lift motor

The lifting motor adopts a three-phase AC variable frequency motor with high power conversion rate, no commutator and brush, and realizes maintenance-free.

(3) Safety & protection features

- ① Polarity protection of the battery
- ② Circuit connection protection
- ③ All inputs are protected against connections errors
- ④ Current overload protection
- ⑤ It have detecting element, limit peak current
- ⑥ Thermal protection

If the controller temperature exceeds 85°C, thermal protection will work; the maximum current reduces in proportion to the thermal increase. Once the temperature exceeds 115°C, it will shut down automatically and give a warning.

If the motor temperature exceeds 145°C, thermal protection will work; the maximum current reduces in proportion to the thermal increase. Once the temperature exceeds 165°C, it will shut down automatically and give a warning.

- ⑦ Battery overdischarge protection

When the capacity of battery is low, there will be a buzzer alarm, the maximum speed and current reduce greatly.

- ⑧ External guard protection

Electric control is hermetical which can protect against dust and liquid into the body.

- ⑨ Starting order protection

The drive request must be issued after the electric lock switch is closed and the vehicle is started.

- ⑩ When electrical elements are damaged, the control can protect itself to avoid more damage.

(4) Operational features

①Close-loop control system make the vehicle speed follow accelerator, which make control easily whether low speed or high speed.

②Two speeds and acceleration designs are available for more work situations.

③Regeneration technology makes direction change more smoothly.

④Three regenerative braking mode:

A. Regenerative brake from accelerator pedal release partly.

B. Regenerative brake from direction reverse

C. Regenerative brake from traveling downhill

Besides increasing driving security, it can recycle parts of electric energy, and prolong work hours of every shift.

⑤Speed control during traveling downhill: motor speed lies on accelerator. If motor speed exceeds the setting value of accelerator, the controller will brake automatically, which gives an optimal protection of ramp.

Notice

- Maintain electric control , must first cut off electrical source, then hold 10-100ohmic resistance join controller anode and cathode, release residual voltage in the capacitor, or else you may meet tip-and-run danger.
- Magnetic and radiation have some effect to inverter, long time effect may mangle controller, So need apart form magnetic and radiation.

Warning and error handling for Inmotion

Serial number	error code	Analysis description	Solution
1	10	Operation sequence fault	Reset all the traction controller switch
2	13	HPG CONTROLLER EEPROM KO	Reset key
3	20	Incorrect start Accelerator pedal switch active before key on	Release pedal switch
4	21	Incorrect start Forward switch or reverse switch active before key on	Turn off the direction switch
5	22	Forward switch and reverse switch active at the same time	Direction switch fault
6	23	Throttle analog value out of range	Throttle fault or analog need to be calibrated
7	24	Throttle analog fault	Throttle fault or analog need to be calibrated
8	30	HPG CONTROLLER BATTERY VOLTAGE LOW	HPG CONTROLLER BATTERY VOLTAGE LOW NEED CHARGE
9	31	Traction controller CAN communication fault	Check CAN wire of controller and display
10	32	BDI level is too low	Need charge
11	33	DC MOTOR VOLTAGE HIGH	RESET KEY
12	34	CPU fault	Reset key
13	35	More than one pump functions are active at the same time	Reset all the pump speed mode switches
14	36	Incorrect start Tilt switch active before key on	Reset tilt switch
15	37	Incorrect start Side switch active before key on	Reset side switch
16	38	Incorrect start Attachment switch active before key on	Reset attachment switch
17	39	Incorrect start Lift switch active before key on	Reset lift switch
18	40	Lift analog value out of range	Lift analog fault or need to be calibrated
19	43	Steer analog value out of range	Steer analog fault or need to be calibrated
20	44	Traction controller speed protection	1、Vehicle speed is too high alarm 2、Traction motor encoder fault
21	45	Traction controller encoder fault	1、Traction controller encoder fault 2、Traction motor speed sensor connection

Serial number	error code	Analysis description	Solution
			wire is open
22	49	DC MOTOR OPERATING CURRENT IS ZERO	1、 HPG CONRTOLLER SENSOR FAULT 2、 Pump motor Open
23	51	Slave traction controller short	1、 Check power wiring 2、 Controller enable before contactor pull
24	52	DC bus voltage of Slave traction controller is low cut back	Battery need charge
25	53	HPG CONRTOLLER OVER CURRENT	1、 HPG CONRTOLLER OVER CURRENT 2、 Pump motor fault
26	54	Slave traction controller over current	1、 Vehicle overload or Mechanical clamping 2、 Slave traction motor speed sensor fault
27	55	DC bus voltage of Slave traction controller is high cut back	DC bus voltage of Slave traction controller is high cut back
28	56	DC bus voltage of Slave traction controller is high cut back(Hardware monitoring)	DC bus voltage of Slave traction controller is high cut back(Hardware monitoring)
29	57	Slave traction controller precharge failed	Replace the pre charge resistance
30	58	Slave traction motor temperature is high cut back	1、 Slave traction motor temperature is high need cool 2、 Slave traction motor temperature sensor fault
31	59	Slave traction controller temperature is high cut back	Slave traction controller temperature is high need cool
32	60	Slave traction controller temperature sensor fault	Slave traction controller temperature sensor fault
33	61	Slave traction motor controller fault	change the Slave traction motor encoder AB
34	62	HPG CONTROLLER TEMPERATURE HIGH	HPG CONTROLLER TEMPERATURE HIGH NEED COOL
35	63	Slave traction motor temperature sensor fault	1、 Slave traction motor temperature sensor is fault 2、 Slave traction motor temperature sensor connection wire is open
36	64	Open drain of Slave traction output open or short	Check the wire of open drain of Slave traction output open or short
37	65	Slave traction Internal power supply	Slave traction motor temperature sensor or

Serial number	error code	Analysis description	Solution
		error	speed sensor connection wire is open
38	66	HPG CONTROLLER BATTERY LOW	HPG CONTROLLER BATTERY LOW NEED CHARGE
39	67	Slave traction motor encoder fault	Slave traction motor encoder fault Slave traction motor speed sensor connection wire is open
40	74	HPG CONTROLLER DRIVER SHORTED	HPG CONTROLLER DRIVER SHORTED
41	76	HPG CONTROLLER COIL SHORTED	HPG CONTROLLER COIL SHORTED
42	78	HPG CONTROLLER VACC NOT OK	HPG CONTROLLER VACC NOT OK
43	79	HPG CONTROLLER INCORRECT START	HPG CONTROLLER INCORRECT START
44	81	Traction controller temperature is low	Traction controller temperature is low alarm
45	82	Traction controller temperature is high	Traction controller temperature is high alarm
46	83	Traction controller temperature sensor fault	Traction controller temperature sensor fault
47	84	Traction motor temperature is low	1、Traction motor temperature is low 2、Traction motor temperature sensor is fault
48	85	Traction motor temperature is high	1、Traction motor temperature is high 2、Traction motor temperature sensor is fault
49	86	Traction motor temperature sensor fault	1、Traction motor temperature sensor is fault 2、Traction motor temperature sensor connection wire is open
50	87	Traction motor encoder fault	1、Traction motor encoder fault 2、Traction motor speed sensor connection wire is open
51	88	DC bus voltage of traction controller is high	1、DC bus voltage high 2、The ramp is too steep
52	89	DC bus voltage of traction controller is low	Need to charge or check power wiring
53	90	The default value of the traction controller is updated	Reset key

Serial number	error code	Analysis description	Solution
54	91	Traction drive limit	Battery low vehicle speed limit
55	97	Open drain of traction output open or short	Check the wire of open drain of traction output open or short
56	98	Traction controller over current or short	Check power wiring
57	101	Traction controller short	1、 Check power wiring 2、 Controller enable before contactor pull
58	102	Traction controller temperature is high cut back	Traction controller temperature is high need cool
59	103	Traction motor temperature is high cut back	1、 Traction motor temperature is high need cool 2、 Traction motor temperature sensor fault
60	104	Traction controller over current	1、 Vehicle overload or Mechanical clamping 2、 Traction motor speed sensor fault
61	105	Traction controller precharge failed	Replace the pre charge resistance
62	110	DC bus voltage of traction controller is low cut back	Battery need charge
63	111	DC bus voltage of traction controller is high cut back	DC bus voltage of traction controller is high cut back
64	112	DC bus voltage of traction controller is high cut back(Hardware monitoring)	DC bus voltage of traction controller is high cut back(Hardware monitoring)
65	114	Traction controller Internal power supply error	Traction motor temperature sensor or speed sensor connection wire is open
66	121	Pump controller temperature is low	Pump controller temperature is low alarm
67	122	Pump controller temperature is high	Pump controller temperature is high alarm
68	123	Pump controller temperature sensor fault	Pump controller temperature sensor fault
69	124	Pump motor temperature is low	1、 Pump motor temperature is low 2、 Pump motor temperature sensor fault
70	125	Pump motor temperature is high	1、 Pump motor temperature is high 2、 Pump motor temperature sensor fault

Serial number	error code	Analysis description	Solution
71	126	Pump motor temperature sensor fault	1、 Pump motor temperature sensor fault 2、 Pump motor temperature sensor connection wire is open
72	127	Pump controller encoder fault	1、 Pump motor speed sensor fault 2、 Pump motor speed sensor connection wire is open
73	128	DC bus voltage of pump controller is high	DC bus voltage of pump controller is high
74	129	DC bus voltage of pump controller is low	Check power wiring
75	130	The default value of the pump controller is updated	Reset key
76	132	Pump drive limit	Battery voltage low need charge
77	137	Open drain of pump output open or short	Check the wire of open drain of pump output open or short
78	138	Pump controller over current or short	Check power wiring
79	141	Pump controller short	
80	142	Pump controller temperature is high cut back	Pump controller temperature is high alarm
81	143	Pump motor temperature is high cut back	Pump motor temperature is high alarm
82	144	Pump controller current calibration error	Reset key
83	145	Pump controller precharge failed	Replace the pre charge resistance
84	148	BMS fault, Parking	BMS fault, Check the battery
85	149	BMS secondary fault	
86	150	DC bus voltage of pump controller is low cut back	DC bus voltage of pump controller is low cut back
87	151	DC bus voltage of pump controller is high cut back	DC bus voltage of pump controller is high cut back
88	152	DC bus voltage of pump controller is high cut back(Hardware monitoring)	DC bus voltage of pump controller is high cut back(Hardware monitoring)
89	153	Pump controller CPU fault	1、 Reset key 2、 Pump motor temperature sensor or speed sensor connection wire is open
90	154	Pump controller speed control fault	1、 Pump speed is too high alarm

Serial number	error code	Analysis description	Solution
			2、 Pump motor encoder fault
91	156	BMS Temperature Warning, Reduce Power	BMS fault, Check the battery
92	157	BMS Temperature Protection, Parking	BMS fault, Check the battery
93	158	BMS Voltage Warning, Reduce Power	BMS fault, Check the battery
94	159	BMS Voltage Protection, Parking	BMS fault, Check the battery
95	161	DISPLAY CAN FAULT	CHECK DISPLAY AND CONTROLLER CAN CONNECTION
96	163	BMS Current Warning, Reduce Power	BMS fault, Check the battery
97	164	BMS Feedback Current Protection, Parking	BMS fault, Check the battery
98	165	Seat switch off after a period of time, the direction of the request to reset	Reset direction switch
99	168	BMS indicates Limit Current alarm	BMS indicates Limit Current alarm
100	169	BMS indicates cutoff Current alarm	BMS indicates cutoff Current alarm
101	170	DC bus voltage of Slave traction controller is low	Need to charge or check power wiring
102	171	DC bus voltage of Slave traction controller is high	1、 DC bus voltage high 2、 The ramp is too steep
103	172	The default value of the Slave traction controller is updated	Reset key
104	173	Slave traction motor temperature is low	1、 Slave traction motor temperature is low 2、 Slave traction motor temperature sensor is fault
105	174	Slave traction motor temperature is high	1、 Slave traction motor temperature is high 2、 Slave traction motor temperature sensor is fault
106	176	Slave traction controller temperature is low	Slave traction controller temperature is low alarm
107	177	Slave traction controller temperature is high	Slave traction controller temperature is high alarm
108	178	Slave traction controller speed protection	1、 Vehicle speed is too high alarm 2、 Slave traction motor encoder fault
109	180	BMS indicates brake Current alarm	BMS indicates brake Current alarm
110	181	BMS CAN Error	BMS CAN Error

Serial number	error code	Analysis description	Solution
111	182	BMS Fault	Check BMS
112	185	Open drain of slave traction output open or short	Check the wire of open drain of slave traction output open or short
113	200	Proportional valve error	Proportional valve error
114	201	Steer controller short	Check power wiring
115	202	Steer controller temperature is high cut back	Steer controller temperature is high need cool
116	203	Steer motor temperature is high cut back	1、Steer motor temperature is high need cool 2、Steer motor temperature sensor fault
117	205	Steer controller precharge failed	Replace the pre charge resistance
118	206	DC bus voltage of Steer controller is low cut back	Battery need charge
119	207	DC bus voltage of Steer controller is high cut back	DC bus voltage of Steer controller is high cut back
120	210	Steer motor encoder fault	1、Steer motor encoder fault 2、Steer motor speed sensor connection wire is open
121	211	Steer motor temperature sensor fault	1、Steer motor temperature sensor is fault 2、Steer motor temperature sensor connection wire is open
122	212	Steer controller temperature sensor fault	Steer controller temperature sensor fault
123	214	Steer controller Internal power supply error	Steer motor temperature sensor or speed sensor connection wire is open
124	217	Open drain of Steer output open or short	Check the wire of open drain of Steer output open or short
125	218	Steer motor temperature is low	1、Steer motor temperature is low 2、Steer motor temperature sensor is fault
126	219	Steer motor temperature is high	1、Steer motor temperature is high 2、Steer motor temperature sensor is fault
127	220	Steer controller temperature is low	Steer controller temperature is low alarm
128	221	Steer controller temperature is high	Steer controller temperature is high alarm
129	222	DC bus voltage of Steer controller is high	DC bus voltage high
130	223	DC bus voltage of Steer controller is low	Need to charge or check power wiring

Serial number	error code	Analysis description	Solution
131	234	Steer Controller Internal power supply error	Steer motor temperature sensor or speed sensor connection wire is open
132	241	HPG CONTROLLER CAN BUS KO	CHECK CAN WIRE OPEN AND CAN SPEED RATE
134	242	HPG CONTROLLER BATTERY OVER VOLTAGE	HPG CONTROLLER BATTERY OVER VOLTAGE
133	243	HPG CONTROLLER KEY SHORTED	HPG CONTROLLER KEY SHORTED
134	244	HPG CONTROLLER WATCHDOG ERROR	HPG CONTROLLER WATCHDOG ERROR
135	245	Attachment switch status error	Reset attachment switch status
136	246	HPG CONTROLLER WAITING FOR MAIN CONTACTOR	TURN OFF THE PUMP CONCTACTOR PARAMETER

FE20XRY

Wire color code:

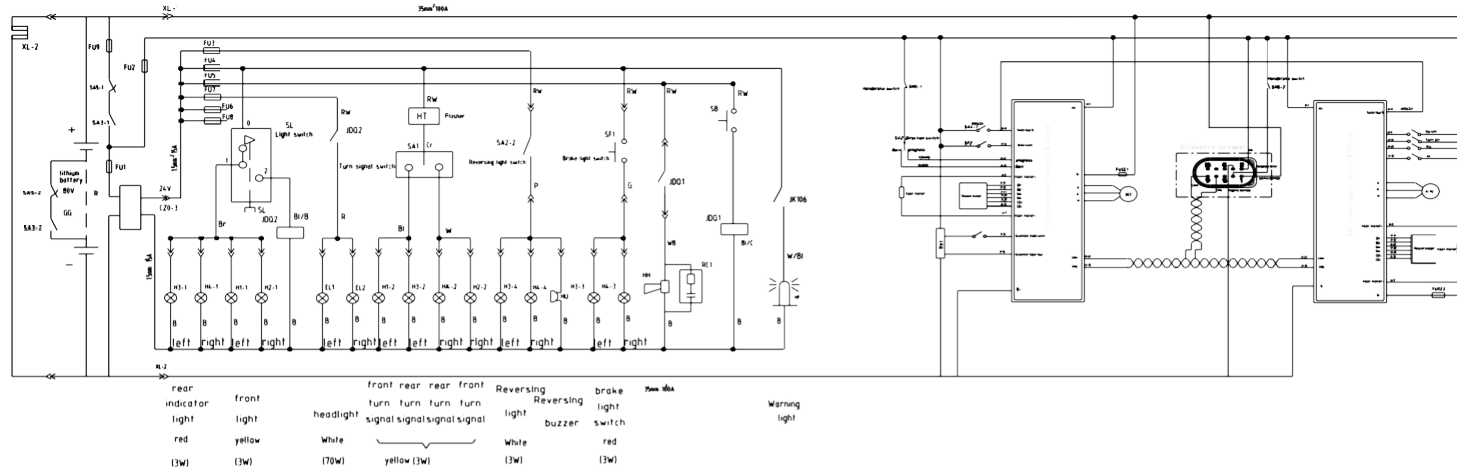
Wire color	White	Red	Green	Yellow	Brown	Black	Grey	Purple	Orange	Pink	
Code	B	W	R	G	Y	Br	Bl	Cr	V	O	P

Note: The remaining unmarked wire diameter is 0.85mm, and the current is 0.8A.

No.	Code	Name	Model number	Specification	Quantity	Remarks
18	HT	Flasher	SG2Z4C	24V	1	(CPDN-15-18A)
17	HH	Speaker	HL58-700200-000	24V	1	(CPDN-15-18A)
16	SF2	Brake switch	JK231	24V/3A	1	(CPDN-15-18A)
15	SF1	Brake light switch	JK231	24V/3A	1	(CPDN-15-18A)
14	ZF	The electromagnetic valve	HCZ5-F18D-000	24V	1	(CPDN-15-18A)
13	SA6	Down switch	Z-15G02255-B		1	(CPDN-15-18A)
12	SA5	Red emergency stop button	ZB4		1	(CPDN-15-18A)
11	SA4	Seat switch	SS-5GL2		(1)	(CPDN-15-18A)
10	SA3	Key switch	4780131		1	(CPDN-15-18A)
9	SA2	Direction switch	SS-5GL		1	(CPDN-15-18A)
8	SA1	Turn signal switch			(1)	(CPDN-15-18A)
7	SL	Light switch			(1)	(CPDN-15-18A)
6	KM	Main contactor	SW200	48V	2	(CPDN-15-18A)
5	RC1	Horn filter			1	(CPDN-15-18A)
4	H3-H4	Three-color rear light		24V	2	(CPDN-15-18A)
3	H1-H2	Front light		24V	2	(CPDN-15-18A)
2	EL1-EL2	Headlight	WD100x90	24V/70W	2	(CPDN-15-18A)
1	GG	acid battery	SP25300	2V	40	

65

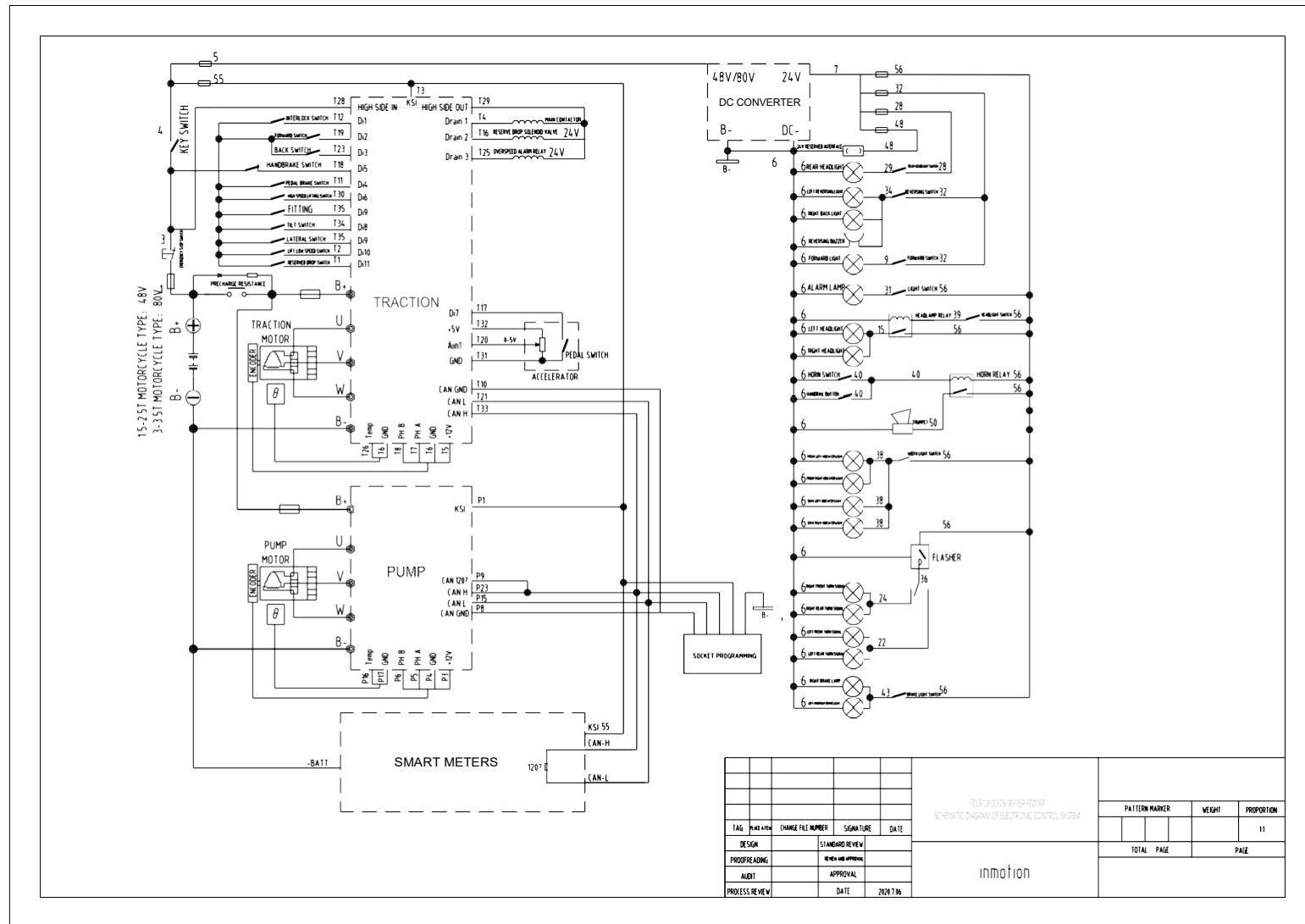
FE15/18/20/25/30/35RYL FE20XRYL FE20XRYLD Electrical system principle diagram



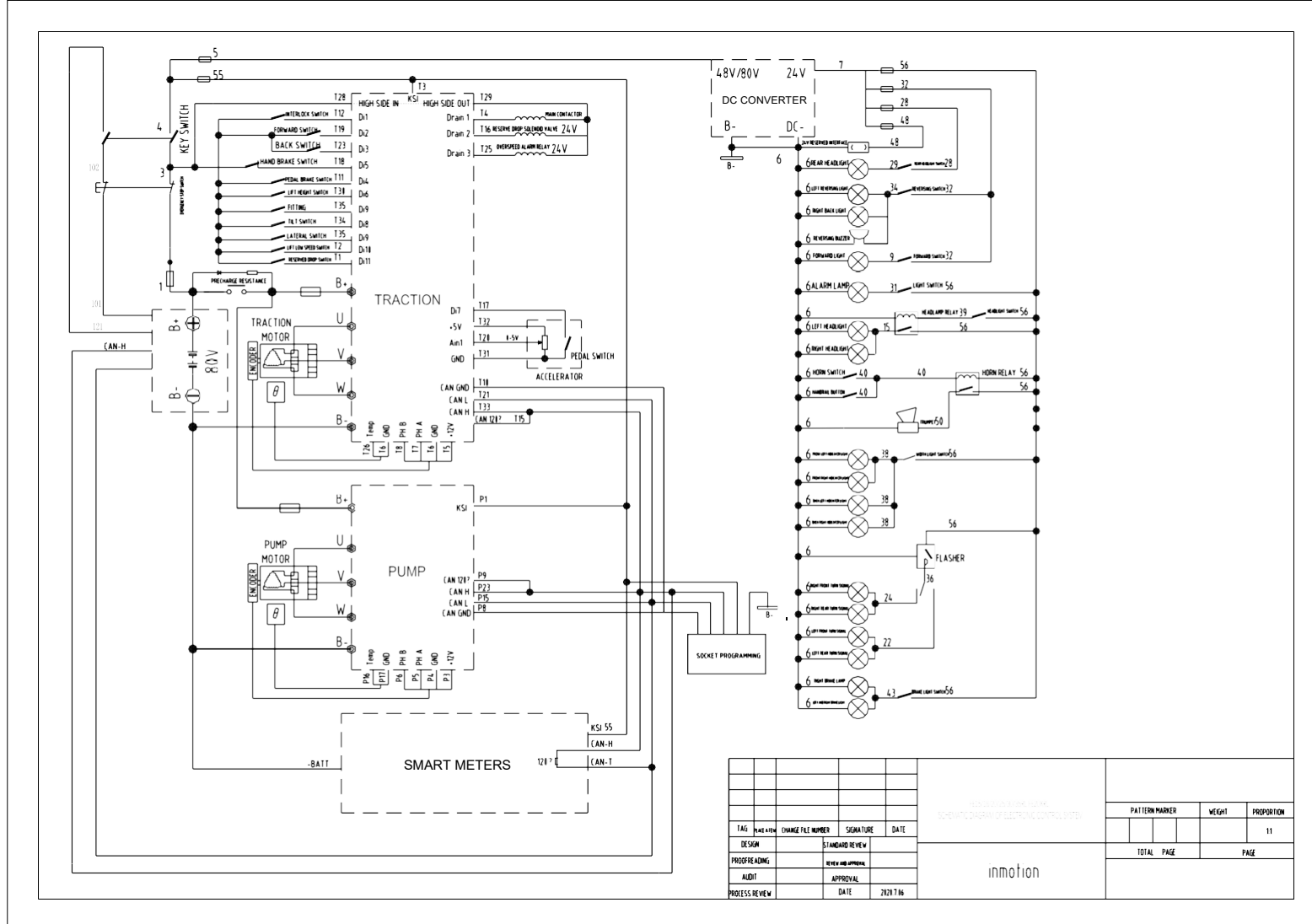
FE15/18/20/25/30/35RYL, FE20XRYL, FE20XRYLD, Electrical system principle diagram

67

68

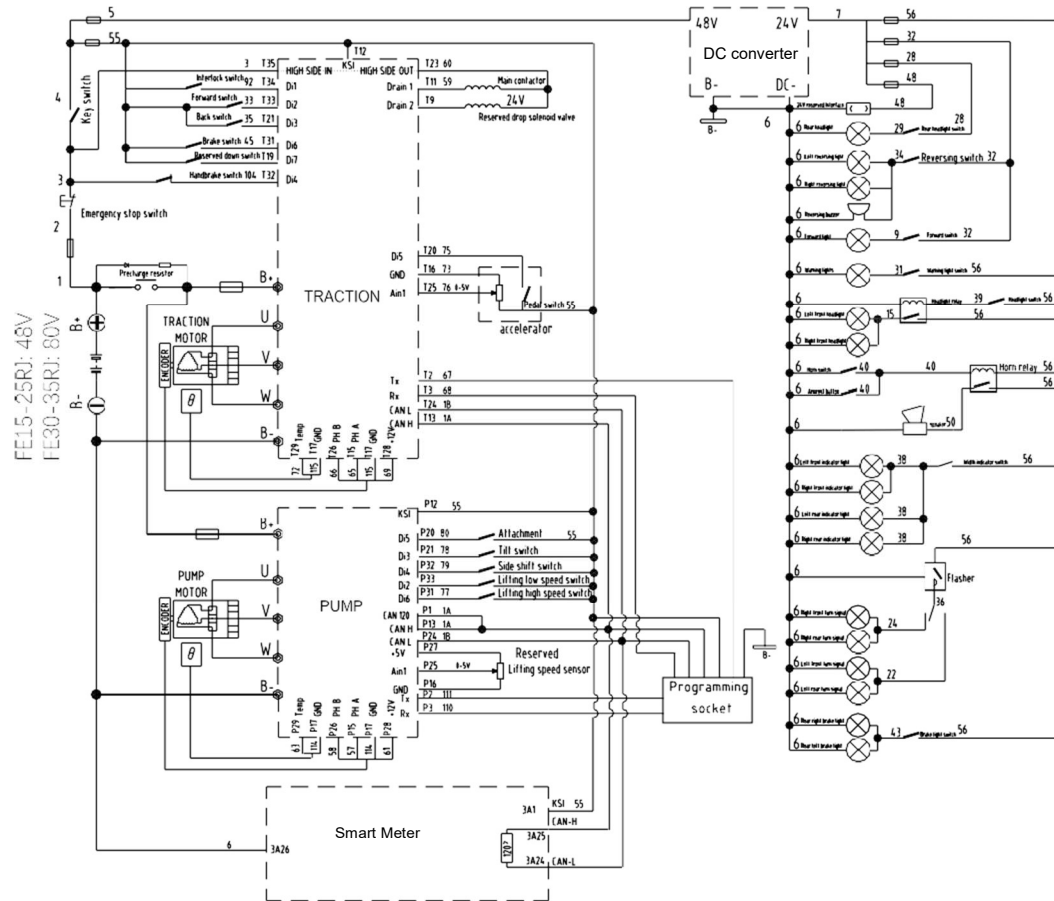


FE15/18/20/25/30/35R, FE20XR Electrical system principle diagram



FE15/18/20/25/30/35RL, FE20XRL Electrical system principle diagram

FE15/18/20/25/30/35RJ Electrical system principle diagram



FE15/18/20/25/30/35RJ, FE20XRJ Electrical system principle diagram

Maintenance record

[illegible]